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ABSTRACT

The transfer of technology from U.S. research universities in cooperation with the private sector is addressed in proceedings of a National Council of University Research Administrators conference. The first discussion session, "New Technology from University Research and Development (R&D)," examines the university research enterprise as a national resource, new technology that supports industry in domestic economic development and trade competition worldwide. Additional sessions cover: "Industry Access to University Technology--Prospects and Problems," "Industrial Affiliate Programs--Windows on New Developments in Technology," "Products and Processes from University Licensing Programs," "New Technology from Cooperative University and Industry R&D," "The Investment Community as Catalyst," "The Role of the R&D Limited Partnerships in the Technology Alliance," "New Company Start-Ups from University R&D," "University Entrepreneurial Subsidiaries and Affiliates: A New Direction?" and "Needed: Comprehensive/Integrated Technology Transfer Programs." Session moderators and participants are identified. Also included are two speeches: "Corporate Research with the Semiconductor Industry" (Edward L. MacCordy and Larry W. Sumney); and "An Enhanced University Alliance with the Private Sector" (Julie T. Norris and Richard L. Van Horn). (SW)

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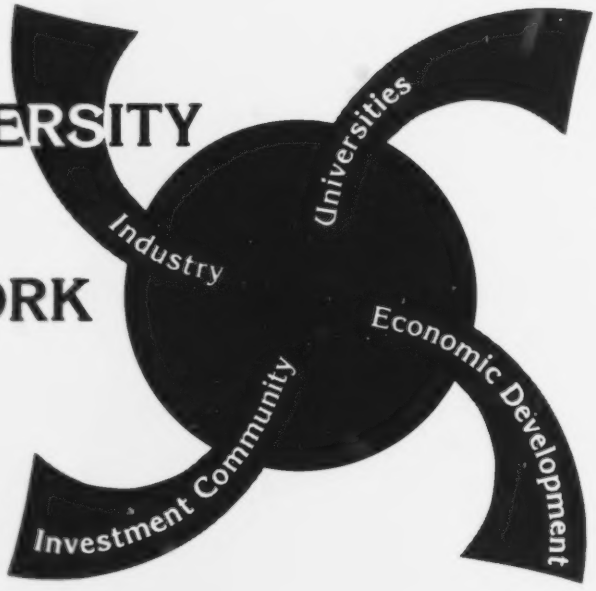
National Council of University Research Administrators

THE PRIVATE SECTOR/UNIVERSITY TECHNOLOGY ALLIANCE – MAKING IT WORK



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The Proceedings of the September 1984 Conference:

THE PRIVATE SECTOR/UNIVERSITY TECHNOLOGY ALLIANCE: MAKING IT WORK

Edited by Earl J. Freise

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TABLE OF CONTENTS

Preface iv

Forward vi

Acknowledgements vii

Opening and Welcome 1
Edward L. MacCordy
Robert H. Rutford

Introduction and Overview
Edward L. MacCordy
Fred Bentley
George Dummer

I. "New Technology from University R & D" 9
Dennis W. Barnes
Donald N. Langenberg
Glenn Bandy
Herbert I. Fusfeld

II. "Industry Access to University Technology--Prospects and Problems" 24
Earl G. L. Cilley
Thomas L. Tolbert
Harvard H. Hill Jr.
W. H. J. Selders
David L. Keaton

Luncheon Address--"Corporate Research with the Semiconductor Industry" 46
Edward L. MacCordy
Larry W. Sumney

III. "Industrial Affiliate Programs--Windows on New Developments in Technology" 54
Phyllis W. Lewis
David C. Johnson
J. I. Goldstein
John Ambrose
Eugene L. Jones

IV. "Products and Processes from University Licensing Programs" 70
Earl J. Freise
Niels J. Reimers
Richard G. Cunningham
William T. Davis
Philip D. Junkins

V. "New Technology from Cooperative University/Industry R & D" 92
Allen J. Sinisgalli
Harold Hall
Max H. Kraus
H. Graham Jones
Richard K. Koehn

VI. "The Investment Community as Catalyst" 112
Anthony Merritt
Patricia Cloherty
S. Leslie Misrock Esq.
Walter Channing Jr.

Luncheon Address--"An Enhanced University Alliance with the Private Sector" 132
Julie T. Norris
Richard L. Van Horn

VII. "The Role of the RDLP in the Technology Alliance" 142
John Dearden
Lee R. Petillon Esq.
Clifford E. McClain
Richard W. Schneider
L. William Miles

VIII. "New Company Start-Ups from University R & D" 167
Harry S. Leahey
Robert E. Mittelstaedt
M. Campbell Cawood
Ian Bund
Steven H. Holtzman

IX. "University Entrepreneurial Subsidiaries and Affiliates-- A New Direction?" 195
Mark Elder
Norris Krone
Thomas H. Moss
Patrick Y. Tam
William Jackson

X. "Needed: Comprehensive/Integrated Technology Transfer Programs" 219
John B. Richey
George B. Kenney
George M. Sladler
Peter J. Ruger Esq.
Jack M. Hollander

PREFACE

In organizing this conference the objective of the National Council of University Research Administrators (NCURA) was to provide insight into changes and new initiatives, some quite embrionic, which are occurring in the creation of new technology by universities and its transfer to and commercialization by private industry. Participation in this process is no longer limited to the patent licensing officials in universities and prominent corporations. New participants are appearing from venture capital organizations, investment houses, law and accounting firms, and state and regional economic development offices. Universities are initiating new or expanded programs and functions to encourage creation and more effective transfer of new technology derived from their research faculties. We have entered a period of change.

It is the hope of those who organized and presented this conference that it will aid attendees and readers of these proceedings in their understanding of what is becoming a rather complex and varied process. We in universities are discovering there are several new alternatives in the creation and transfer of new technology and that these alternatives require the development of cooperative alliances with organizations with whom we have not previously dealt. To develop effective new alliances requires the acquisition of additional knowledge, skills and abilities and an understanding and appreciation of business and financial activities with which we have little prior experience.

For two and one half days, university representatives listened to, questioned, exchanged viewpoints and socialized with an interesting set of professionals from a variety of business and financial cultures. It stimulated new ideas as to what we and our institutions might do to better serve society through creation and transfer to the commercial sector of useful new technology. In turn, we hope that our guests acquired a better understanding of university culture and our desire to have university research activities increasingly contribute to society's welfare, industrial competitiveness and economic development.

This conference was a success and filled a significant need for attendees due to the voluntary and enthusiastic participation by, and the thoughtful presentations of the discussants from private industry, management organizations and universitities. For the willingness of each discussant to share his/her knowledge, experience and ideas we are sincerely grateful. Our gratitude is also extended to the conference chairman, George Dummer, and the session moderators, the adhesive which held the diverse topics together giving us unity, perspective and continuity.

The planning, organizing and conduct of the conference could not have been accomplished without the insight, initiative and untiring efforts of Fred Bentley from Stanford University, then Chairman of NCURA's Professional Development Committee. We especially appreciate the guidance and constructive suggestions, though sometimes painfully critical, of George Dummer of MIT and Tony Merritt of the University of Pennsylvania. Of course, the conference would never have been produced without the encouragement and support of the officers and the Executive Committee of NCURA.

Arrangements for a meeting like this, a thousand miles from NCURA's office in Washington, involved a myriad of essential details any one of which if not done well could have caused discomfort, irritation, disruption, distraction and failure of the conference to accomplish its objectives. We were blessed with two pros who through their indefatigible efforts under very trying conditions made extremely thorough and effective arrangements resulting in an enjoyable and productive conference. To Natalie Kirkman, the Director of NCURA's national office, and Kathy Larmett, Assistant to the Director, our most sincere thanks for the magic they worked.

As they say, "last but not least" is our gratitude to those primarily responsible for production of these proceedings. Earl Freise, current President of NCURA, has almost single handedly put these proceedings together, from translation into plain English of garbled transcriptions to harassing moderators, discussants and others to promptly edit and return their presentations. His untiring devotion to this task in the face of an excessive personal workload at the University of Nebraska and as President of NCURA is sincerely appreciated. As noted elsewhere, NCURA is especially grateful to Carol Goodman and Coopers and Lybrand for financial assistance in the publication of these proceedings.

If the reader gets nothing else from these conference proceedings at least he/she will learn the real differences between large and small companies and the principal institutions in this world which have survived without significant change in form over the past 350 years.

Edward L. MacCordy
Washington University

September 1985

FORWARD

Coopers & Lybrand is pleased to assist the National Council of University Research Administrators in publishing the proceedings of the conference The Private Sector/University Technology Alliance--Making It Work, held in Dallas, Texas, September 4-7, 1984. Universities contribute a key resource--new knowledge in science and technology--to our ability to meet international economic competition. Conference participants discussed existing and potential dimensions of technology transfer and reciprocal support which constitute the university/private sector partnership. Continuing growth and creativity in that partnership are critical to the vitality of American higher education and of our economy.

Numerous choices beyond the traditional philanthropic and sponsored research models now enable university and business representatives to forge new links of cooperation. Careful analysis and selection of options, sound planning and management methods compatible with the university environment, and innovative financial and tax strategies suited to the transaction at hand--all these will contribute to the success of the emerging university/private sector technology alliance. All of us who are interested in the vigor of higher education can learn from the ideas and strategies discussed in the pages that follow.

Clark L. Bernard
Chairman, National Higher Education Group
Coopers & Lybrand
One Post Office Square
Boston, Massachusetts 02109

Suzanne H. Woolsey, Ph.D.
Partner, Management Consulting Services, Higher Education
Coopers & Lybrand
1800 M Street, NW
Washington, DC 20036

October 1984

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As editor of these proceedings, I would like to express my appreciation to Ms. Debbie Ruthsatz and Ms. Mary Severs for their many hours at the word processing keyboard and printer to produce the final manuscript. To the staff of the national office, Ms. Natalie Kirkman and Ms. Kathy Larmett, I wish to say thank you for taking the manuscript and getting it into a printed and bound publication. Finally, I would say thank you to all the moderators and panelists, and especially to Ed MacCordy, for your cooperation and patience in this undertaking.

Earl J. Freise
University of Nebraska-Lincoln
Lincoln, Nebraska

January 1986

MR. MACCORDY: Ladies and Gentlemen.

Dr. Robert H. Rutford, President of the University of Texas at Dallas, is our gracious host for this conference. He is an accomplished geologist and has held senior academic administrative positions at the University of Minnesota, the University of South Dakota, and the University of Nebraska before assuming the presidency of the University of Texas here in Dallas. Especially notable are his contributions to geological studies on this continent and in Antarctica. From 1975 to 1977 he served as Director of Polar Programs at the National Science Foundation.

In planning and organizing this conference, Bob Rutford has been of invaluable assistance to us, for which we are sincerely grateful. We are proud to have him as a member of this organization, the National Council of University Research Administrators. This morning I would like to invite Dr. Rutford to make a few remarks.

MR. RUTFORD: Thank you Ed. I would like to welcome you to Dallas and this National Conference on the Private Sector/University Technology Alliance. It is especially fitting for us that this conference be held here at this time.

During the last year there has been an awakening by all concerned to the need for such an alliance here in the Dallas/Fort Worth Metroplex and the State of Texas. Many of you know the story of MCC coming to Texas. The culmination of events that led to their decision to locate in the city of Austin had an impact here in Dallas that has been positive in all ways. The wooing of MCC brought together for the first time the presidents and chancellors of Texas A & M and The University of Texas at Austin, the Governor of the State of Texas, representatives of the city of Austin, bankers, and industrialists, who joined together, set aside old differences, and were able to convince members of the MCC board that the city of Austin was the place to locate.

I have to tell you that that caused some problems here in Dallas. There is great pride in the city of Dallas and in the Metroplex. There are over 800 high-tech firms located in the city of Dallas. Within three miles of where you are sitting, there are at least a hundred and fifty high-tech firms, located just to the north of the North Dallas Parkway, and the Toll Road, or its extension. There are over 120,000 employees in high-tech industry in Dallas in the 800 firms, and 85 percent of those firms have less than 100 employees.

People in Dallas tend to think that the big firms are TI, Rockwell, Varo, and to the west of us, in the mid-cities area, Bell Helicopter and LTV, and in Fort Worth, General Dynamics. What happened as a result of the MCC decision, was that Dallas Mayor Starke Taylor put together a high-tech task force consisting of representatives of all industries, banks, venture capital groups and higher education, and in approximately 65 days, four subcommittees of that task force put together a report for the mayor that pointed

out that what had happened was that Dallas has ignored its own backyard. The necessary interaction between the fourteen institutions of higher education in the North Texas area and industry in this city simply did not exist. Any form of alliance in which everybody understood what the needs of the industry and the universities were or what the universities had to offer to industry and what industry could offer to the universities had not been considered.

A year and a half ago in Dallas, a firm in the high-tech area that sought venture capital funding was almost always turned down by the local banker. In the past year a fellow by the name of George Kozmetsky, who some of you may know, organized a conference on technology and venture capital here in the city of Dallas that began to get people thinking about the need of venture capital. As a result, nine or ten venture capital offices of major east coast firms have moved to Dallas. In addition, venture capital firms have started here in Dallas, and the largest banks in Dallas now have vice-presidents in charge of high-tech or venture capital making it much easier to obtain capital for high tech endeavors.

In addition, the Mayor's high-tech task force has continued to function. One committee headed by the former chief executive officer, and now chairman of the board of Texas Instruments, is looking at the whole business as a "blueprint" for higher education and the role of industry in support of higher education in the Dallas area. That subcommittee is just gearing up, and they hope to have a report before the end of this year.

A second subcommittee headed by a former chief executive of Texas Oil and Gas will look at the concept of industry forming a consortium to provide, through a non-profit foundation, funding for research activities. That is, funding would come from industry and would be available to universities for research in areas of interest to industry.

In addition, there have been a number of small busines high-tech, venture capital-type conferences held here. The awareness that has come to this area of Texas about the need for an alliance between the private sector and universities is one that has been very stimulating to me, and has been very, very stimulating to the people in industry. One of the vice-presidents of a local firm recently said to me that they now realize that they provided support to universities all over the country and have neglected the universities in the local area.

You will now find here in Dallas a community that is awakening and becoming much more aware of the need for this private sector/university alliance.

On behalf of all of us, welcome. We hope we will have an opportunity to interact with you, and as you return to your universities, or to your corporations across this country, I would implore that you heed the words of my friend, Bernie List, who made the comment, "Don't ignore your own backyard. There may be more out there and more opportunity there than any of you think there is at this time."

Ed, you have done very well with the weather. When Ed and Earl Freise were here a month or so ago, the temperature was 106. I guaranteed them that it would cool down by the time of the conference. I hope that it continues to be cool on the outside. I also hope that the discussions here inside generate some activity, some heat, and certainly some understanding of the problems and the needs of all of the sectors involved in these discussions, and that from this meeting comes positive connections that will have payoffs in the future.

Thank you very much.

MR. MACCORDY: Thank you, President Rutford.

I still don't understand how somebody that spent a greater part of his career in Antarctica could ever choose to settle in Dallas, Texas, with the summers here.

INTRODUCTIONS AND OVERVIEW

MR. MACCORDY: I am Ed MacCordy, President of the National Council of University Research Administrators, and I welcome all of you to this conference and hope that it will be of great benefit to you when you return to your places of business, wherever that might be.

I would also like to extend a special welcome to our Canadian colleagues and friends, who have a large contingent here today. We enjoy having you with us, and hope that the conference will be of significant value to you although you are taking the lessons of it back into a system that differs from ours.

Before getting on with the program, I would like to make a brief comment as to the purpose of the conference. The NSF's statistics on research expenditures at universities, which were contained in your registration packet, demonstrate that university research is a massive national resource created and supported primarily by public funds. If maximum public benefit is to be achieved from this resource, then a cooperative alliance among the sectors represented here today is an absolute necessity. These sectors include the universities, the investment community, and industrial firms of all types and sizes, especially those participating in economic development at the regional, state and local levels. The purpose of this conference, then, is to start a dialogue among those sectors which we hope will result, in time, in a working alliance for public benefit.

At this point, I would like to introduce the director of the conference, Fred Bentley, from Stanford University, who is also chairman of the Professional Development Committee of NCURA.

MR. BENTLEY: Thank you, Ed.

Part of my job today will be to try to keep things on schedule, and as I look at the schedule, we are due to begin with the first panel at 8:30. Prior to doing that, there are a few housekeeping things that I think may be in order.

You will take notice there are some salmon colored slips at the edges of the tables. We request that participants who have questions of the various panels write out their questions on the slips, which will be collected and given to the panel moderator. The moderator will arrange the questions with an objective of avoiding redundancy and providing continuity.

Since the conference was announced, we have been fortunate enough to receive a generous contribution from Coopers and Lybrand to help NCURA publish the proceedings from this conference. The proceedings will be available to all who are registered free of any additional charge. However, we do request that you sign up at the back registration table indicating your desire to receive a copy. A member of Coopers and Lybrand and a member of NCURA, Carol Goodman, was very instrumental in acquiring this gift to us, and we are grateful.

I ask that you keep your eye on the bulletin board in the registration area for messages. The bulletin board is there to help facilitate those meetings of people who know that their counterpart is here but have not found that person. So, if you would periodically check the bulletin board, that will help ensure that you receive messages.

I think that concludes the first set of announcements. If there are things that come to your attention that you would like rectified, let me know or let the staff at the front desk know, and we will do our best to try to keep this conference moving smoothly for you.

That leads to my next task, which is to introduce the conference chairman, George Dummer. George is Director of the Office of Sponsored Programs at MIT. He is a person who might be known to many of the university people here and a person I am sure that the rest of you will enjoy meeting. George has been a colleague of mine for many years. I worked at MIT for a while and that is why people still tell me I talk like a New Englander. George is a person who has dedicated a lot of his time to the improvement of research administration at universities. He is a very knowledgeable person, a person who I am sure you will find contributes a great deal to this conference.

Without further ado, George will you please come forward?

MR. DUMMER: Thank you, Fred, and good morning to you all. It's good to see you here today. As you know from the program announcement, the primary objective of this conference will be to explore means of improving the transfer of technology from the nation's research universities through an alliance with the private sector. Before we look at these means, however, let us take a few minutes to ask ourselves why.

Why, from the standpoint of industry, should we be doing this?

First, you all know that this country is in a competitive struggle with other industrial countries for markets in advanced technologies. The United States has not realized the full potential of these technologies, and the university-industry relationship is part of that unexploited potential. To compete with the rest of the world, American industry needs American universities.

Second, the line between basic research and its application, especially in the high-technology fields, has blurred. As a result, fundamental research often provides solutions to industrial problems and in a much more immediate time scale than we have known before. Thus, technological and economic progress increasingly demand an unprecedented understanding of the underlying physical and biological phenomena which are the principal focus of university research.

Finally, manufacturing itself is changing. The very act of trying to make something raises fundamental issues. For example, in producing microelectronic circuits to micron dimensions and below creates new phenomena that have to be dealt with. This, in turn, demands the knowledge of those working at the frontiers of science.

These are only a few of the factors which are compelling reasons for industry participation in this alliance to transfer technology. But how about the universities? What brings us to this alliance, and what will we gain from it?

Well, money is certainly one reason, but it is only one reason, and lets not overrate it. Government sources will inevitably remain the mainstay of university research, but in an era of reduced federal funding, private support grows more essential. It is a way of suporting studnets and post doctorals, buying equipment and, perhaps, maintaining a more stable research base. But beyond research costs, the chance of realizing significant profits from the results is highly speculative, and not, at least from my experience, the reason that most faculty members seek outside support.

I firmly believe that a powerful incentive for the interaction with industry is, in fact, intellectual. The flow of knowledge is not unidirectional but comes from many sources in many ways, and there is value in the feedback and views from industry. It helps to assure the relevance of educational programs to important problems of society. Students and faculty who have relatively little exposure to industrial problems and motivations can be enriched by interactions of the right kind. It gives the students the kind of problems textbooks can never duplicate. And, after all, most students seek employment in industry.

Finally, industry is the agent through which the benefits of science and technology are transferred to the public. It is a natural desire to see the fruits of reserach find their way into practical application. We all like to see our intellectual, as well as our biological offspring, succeed in the world. Universities are one of the primary sources of creative thought in society, but we all know that creativity does not in itself ensure the transfer of invention to the world in a useful way.

These then are just a few of the incentives which bring us together. Now, let's go back and take another look at the objective of this conference as stated in the program announcement. You will note that I have omitted a portion of it. Our objective is not only to improve the transfer of technology from the nation's universities, but to do it "with due regard to preservation of the historical independence and objectivity of university research scientists and engineers."

We all know that the prospect of increased university industry interaction has created anxiety on the campuses of many universities, in the news media, and in the Congress, triggered in part by the so-called biotechnology boom. We have read the headlines: "Pure knowledge versus pure profit"; "The Glimmer of Gold in the Ivory Tower"; "Business and Universities - Uneasy Bed-Fellows"; and so on. But what is the cause of this concern? Derrick Bok of Harvard University has characterized it as, "an uneasy sense that programs to exploit technological development are likely to confuse the universities central commitment to the pursuit of knowledge and learning by introducing into the very heart of the academic enterprise a new and powerful motive--the search for utility and commercial gain."

As a result of this uneasiness, the university/industrial/private sector interaction has been subject to critical examination from within and without. We have explored a range of problems relating to issues of academic freedom, and the right to publish and disseminate research results. We have examined conflicts of interest, conflicts of commitment and the mechanisms of full disclosure; the implications of co-mingling of federal and industrial funds; how to preserve university objectivity and credibility; and who determines the direction of university research and the selection of research topics.

This critical self-examination and scrutiny will continue, and each individual university must weigh the risks and establish those links with the private sector which make sense in terms of its own programs, values and traditions. But the essential fact remains, that to make their greatest contribution, the universities and the private sectors need each other.

We know that there are mismatches in the respective value systems and the time constraints of universities and industrial firms, but we have in the past, and will continue, to overcome the barriers and bridge the gaps. There are no absolutes to guide us, and no perfect models that suit all of us. It will require common sense and balanced judgment and, above all, a continuing effort by each of us to understand the other and to search out the common ground.

Well, now let's turn to the sessions which Fred has mentioned. We will be looking at a variety of models and mechanisms by which universities are interacting with the private sector in the transfer of technology. And in many ways, we'll be looking at moving targets, because nearly every type of interaction is in a state of flux. It is true of cooperative research, of patent licensing, of affiliate programs, and so on. We will come to each of these in time. For the moment, let me simply note in passing that perhaps the greatest ferment of all involves two groups with which the universities have had very little organized communications: the investment community and those involved in state and regional economic development.

Looking first at the role of the investment community, I doubt that many of us can recall a period when so many start-up companies and other new ventures have sprung from university research laboratories.

In those cases (biotechnology is one example) where the potential for commercialization is high, and the time span very short, new ventures have been created and financed while the science and technology was still being developed in the university laboratories. This has brought university faculty into formal relationships with new corporate ventures as consultants, directors, and even operating officers, sometimes taking leaves of absence, and sometimes taking leave of the university. This in turn has led a number of universities to examine a variety of new mechanisms for becoming involved in the growth of business ventures, either directly or indirectly through so-called third party buffering organizations.

At the same time, and frequently in conjunction with such new ventures, the investment community has become active in the formation of research and development limited partnerships. Some provide off the balance sheet financing for companies funding university research, but a growing number involve the direct and active participation of the university, itself, in their conception, formation and implementation.

With respect to state and regional economic development, there is an accelerated pace in state and regional development activities designed to stimulate economic growth. Some regions are seeking to take advantage of recent advances in high technology fields and apply them to local industrial activity. Economically depressed areas are particularly interested in the creation of the new jobs through the development of new high-technology start-up companies. Many of these activities involve the development of research parks and incubator programs in which universities and university faculty are actively participating.

Well, that in brief, is where we are and why we're here. Now it's time to look more closely at this alliance and talk about how we are going to make it work.

This brings us to our first session, "New Technology from University R&D." This session, in a sense, sets the stage for the rest of the conference. It will look at the university research enterprise as a national resource; new technology as a driving force for private industry in domestic economic development and international trade competition; and the growing cooperative relationship between the two sectors.

To moderate session number one, it is my pleasure to introduce Dennis Barnes, Associate Vice President of Government Relations at the University of Virginia.

SESSION I

NEW TECHNOLOGY FROM UNIVERSITY R&D

MR. BARNES: If my panelists will join me on the platform, I will start as they are coming up. As a pre-1980 past President of NCURA, this kind of event is notable, because I realize that only a few years go we could not have put on a session like this. The issues we are going to discuss and the terms we are going to use had not been invented yet. There certainly would have been a lot of argument in the academic world if we had said that these issues would be topical.

I got an interesting glimpse of the circumstances under which we are operating in 1981 when I took a leave from the University of Virginia to serve as chief scientist for the Senate Committee on Commerce, Science and Transportation. The Bayh-Dole patent legislation which gave patent rights to universities, non-profits and small businesses had just been passed as had the Stevenson-Wydler Technology Innovation Act. A new administration then came in, whose attitude was to shift responsibility for innovation to the private sector by providing incentives for the assumption of risk. Incentives appeared in the 1981 Economic Recovery Tax Act (ERTA), in the form of investment tax credits, and credits for donation of equipment to universities, along with the liberalizing or relaxing of some of anti-trust restraints. There was a dramatic dropoff in federal funding of demonstration and development energy projects which were viewed as more appropriate responsibilities of the private sector.

The Stevenson-Wydler Act, passed with fanfare at the closing of the previous administration, was stillborn. The Act calls for the government to determine where the technical interest should be, which is supposed to be out of keeping with the new administration's philosophy.

But the philosophy has not been uniform. Witness the Small Business Innovation Research Act, which the administration initially, adamantly opposed. I probably represented as close as there was to an opposition in the Senate. What seemed to me to be quite respectable grounds for opposition were that the SBIR called for the government to try to pick commercial winners and the set-aside provision ran the danger of skimming money from basic research. Eventually the administration capitulated and the legislation passed 97 to nothing in the Senate, including the vote of Senator Harrison Schmitt, the Chairman of the Science Subcommittee for which I worked.

The Bayh-Dole patent legislation did not extend to big business; Congress seems to have drawn a line, that determines that what is fair and equitable for small businesses and non-profits is not for a General Electric or a General Motors. There is a strong populist sentiment that Senator Russell Long has asserted effectively that says that the Federal Government should not create private benefit at public expense. Senator Schmitt tried three times, unsuccessfully, to extend Bayh-Dole to big business; Senator Dole is attempting the same thing now.

While the Stevenson-Wydler Act appeared to be stillborn, some of the provisions in the Act are showing up as administration initiatives such as NSF's Engineering Research Centers.

We hear about cooperative R&D with industry and there is a lot of legislation to this end in Congress now. Senator Gorton's manufacturing technologies legislation has passed the Senate and there is companion legislation in the House. Several bills would make permanent the R&D tax credit for industry sponsorship of university research. However, the Treasury, and I think a lot of other people, have yet to be persuaded that the payoff from this incentive offsets sufficiently the federal revenue loss.

The environment in which we are working is in flux. Many of the concepts that we are embracing so eagerly now, will be tested; some will succeed, and others will certainly fail.

An interesting factor that has emerged is the role of the states, who have not been a major factor in the tripartite relationship that we talked about for years among universities, industry, and government. There may be more experimentation going on now at the instigation of the states than any of the other players. This brings us to the purpose of this session which is to provide an overview of the university research enterprise. We will also talk about new technology as a driving force for private industry, and the growing cooperative relationship among the sectors.

Joining me, first, is, on my left, Don Langenberg, Chancellor of the University of Illinois at Chicago. Prior to that, he was Deputy Director of the National Science Foundation serving in both the Carter and the Reagan administrations. Previously, he was the Vice-President for Graduate Studies and Research at the University of Pennsylvania and also a Professor of physics. He is well know to a number of us, as a past board member of the Council on Government Relations (COGR)and as a member of the National Council on Research, (NCR).

On my far right is Glenn Bandy, who is Technical Manager in the Engineering Systems Department, Equipment Group of Texas Instruments, where he has been an employee for thirty years. Glenn has been very active in TI's program of assistance to educational institutions; he has been particularly involved with the University of Arkansas. His background is in electrical engineering.

To my immediate right is Herb Fusfeld, Director of the Center for Science and Technology Policy, which is part of the graduate school at New York University. Previously, he was Director of Research at Kenicott Copper and prior to that, Director of Research at American Machine and Foundry. He has a long list of professional activities, which include the past presidency of the Industrial Research Institute, and the governing board of the American Institute of Physics; he has a doctorate in physics.

The three panelists will make their presentations in the same order as I introduced them; then we will respond to the collected questions. The first panelist is Donald Langenberg.

MR. LANGENBERG: Thank you.

Dennis has suggested that I might begin by presenting the university point of view on this rather exciting and very active topic we have met here to discuss. I can't do that, because I don't believe there is a specific unique "university point of view." One of my colleagues is fond of describing that person, who is the heart of any university, a faculty member, as a person who thinks otherwise. That same insistence on holding independent views characterizes universities as institutions. Therefore, it is very difficult to create and synthesize the university point of view and to communicate it. I have a personal point of view, however, which I suspect will be revealed during the course of our discussion.

I thought it might be useful at the beginning of this session to step back and take a broad view of universities, our universities, in this country, in order to try and put on the table some of the things that make universities different from other institutions in our society, some of the things that often lead to misunderstanding, misapprehensions, and difficulties in the emerging relationships between our universities and between the private sector and governmental entities.

In 46 B.C. Cicero wrote that to be ignorant of what occurred before you were born is to remain always a child. A childlike faith in the future may be useful for the kinds of things that we are talking about, but I think a childlike ignorance of the past is not. Therefore, I think it is useful to step back and take a historical look at universities. We all think we know about universities. A lot of us here work in them. Almost all of us went through one. You have only to turn on the television any Saturday afternoon in the autumn, and they are right before your eyes; The University of Texas or the University of Illinois or Penn State. But I do believe that universities are widely misunderstood, not only by persons outside them, but very often by persons inside them. I have spent the majority of my life in universities either as a student, a faculty member or an administrator, and the longer I spend in them, the less I understand them.

It has been observed that sixty-six institutions have survived continuously to the present day in essentially the same form since the time of the Reformation, 1530, and of those sixty-six, sixty-two are universities. I think it is worth pondering that interesting fact because it says something that is terribly important about our universities. We sometimes get the impression at meetings like this that things are in a state of flux, and they are (practically everything is up in the air!); that things are moving almost more rapidly than we can understand, and they are. Nevertheless, I think it is useful to remember that of all of the institutions created by man, with very few exceptions, our universities are the most stable and resistant to change. And in that enduring quality is the source of many of their virtues and also many of their defects. It is interesting to speculate on what in the character of universities accounts for that incredible stability. It is certainly not military or economic power. The institutions having those powers are far less stable than universities. Possibly it is philosophical power, or intellectual power. I really do not know what it is, but nonetheless, universities have a power to endure.

In our ancient universities there arose early on, a concern for fundamental ideas and fundamental values. This occurred despite the fact that universities were created as "trade schools" - places to educate a few of the young elite for service in the state and in the church. This focus on fundamental ideas and values brought with it a certain uneasiness about the immediate and the practical, and a tendency to function on a very long-term time scale, a very relaxed time scale. There, too, is the source of much of the strength of our universities and also many of their defects.

There also arose rather early in our universities the notion of the importance of scholarly independence; more recently described as academic freedom, and the notion of colleges and universities as essentially voluntary associations of free and independent scholars, as intellectual communes, if you like. That has a rather profound implication for the way universities work. That idea persists to this day, despite all influences to the contrary. It is a very powerful idea. It has led to the development of institutions which really do not function quite like any other institution that man has created. The differences are often described as involving much more of a bottom-up management than top-down. That certainly doesn't describe all of the reality, but I think it is important for everybody to realize that this is the case to a substantial degree within universities.

There arose in the 19th century a new kind of university; today, typically called a research university. It seems to be a German invention, now imported widely around the world. Nowhere, I think, has it been more thoroughly accepted or intensively pursued than in the United States. It is an institution based on the acceptance of a notion that not only does a university have as its fundamental functions the safekeeping of knowledge gained in the past and its transmission from one generation to the next, but that it has a mission to create new knowledge. It is worth noting that this is a relatively new idea, probably not more than a century or so old. With that new idea came some additional features that are characteristic of our present day universities, features which have been found important to the development of scholarly inquiry or research.

One of these important features is open communications between scholars working in the same field, as a means of ensuring the most rapid possible advance, and also as a means of laying claim to what is probably the most important reward sought by most active scholars and researchers, the respect of their peers - fame, if you like. This kind of reward, I think, is really what drives, many faculty researchers in universities. The same reward does not drive most people in our society. Most are driven by acquisition of personal resources - money. I would not stand here and claim that faculty are not interested in money (God knows they are!). Nevertheless, that is not the principal driving force in their lives, and that needs to be borne in mind. That motivation includes strong feeling for the importance of priority in publication. Here, perhaps, is a case where reality runs counter to the general tendency of universities to take the long view. Sometimes it even leads to a little unseemly haste in publication.

There is another 19th century university invention, and it is an American invention. The Morrill Act, passed by Congress in 1862, called for the transfer to the states of lands to provide for the support and promotion in agricultural, mechanical and military arts, which led to the establishment of our great land grant university. It has been, I think, one of the most evidently successful

public innovations in all of history. That and the Hatch Act that followed a decade and a half or so later were really the first entry by the federal government into a partnership with states. It was aimed at what we would now call technology transfer, the creation of technology and its transfer to what was then the nation's major industry, agriculture. Experience over more than a century shows that there have been close working relationships between universities, university researchers, and the agricultural industry. This was perhaps a somewhat peculiar industry because, for much of that time, the typical agricultural industry was not a large corporation. It was an individual family farmer working with a spouse and maybe a couple of children and maybe a brother-in-law; small business, very small business. Some of the things we have learned from agricultural extension may therefore not be transferable to today's relationships with large industries, but they may be with small industries. I am quite sure that somewhere in that century's worth of experience is much from which to learn, and many good ideas that do not have to be re-invented.

University research became big business in this country as a result of World War II. Before that war, university research was confined to a relatively small number of institutions. I doubt very much that one could claim there were more than two dozen research universities in this country before World War II. There are many more now, as a result of the realization during the war of what research can mean to the country's military and economic effectiveness. If you look at the numbers that have been provided in the packages given to all of you, you will note that in total R&D expenditures, we are now running a seven or eight billion dollar a year research enterprise in our universities, the great majority of this coming from federal government and from taxpayers.

So, what are the features of our universities today that are important in thinking about possible relationships with other types of institutions? I think we do need to bear in mind that universities, despite the fact that they are sources of change, of innovation, are at the same time stable, resistant to change, and heavily influenced by tradition. I think we must remember that universities speak with many voices, sometimes discordant voices, that there is no "university position." I hope nobody here will quote me to my friends in Washington or One Dupont Circle, but I think they would agree that while it is sometimes possible to establish a university position on a particular issue, to do so is always difficult and often impossible. Universities do not speak with a single voice. Collectively, or even within the same university, it is practically impossible for a president or a chancellor or a dean to get up and say, "I speak for universities or my institution or my college." You can get away with that sometimes, but you are always going to feel just a little bit uneasy about it. Those of you who are members of NCURA and who have been through the indirect cost wars will probably remember the outrage of several government officials when they discovered that after some protracted period of negotiation over a proposed revision of A-21 with all of the right associations, there would come a university research administrator or a faculty member saying, "I object! That's ridiculous! It won't work!"

Universities <u>are</u> bureaucractic, but in ways very different from other institutions. Universities <u>are</u> large and complex these days. But they are also full of very independent people who matter. Now, independence is perhaps the single most common characteristic of entrepreneurs. So one would imagine universities to be a fertile source of entrepreneurship, and they are. But we must remember that those same entrepreneurs, as members of the university, display other characteristics of a more conservative tradition-bound kind.

Having presented a few ideas that I think need to be borne in mind as we continue to talk about the relationships between universities and the private sector, let me close, with the the hope that we can move on to discussion of more detailed and less general aspects of the issue before us. Thank you.

MR. BARNES: Thank you, Don.

Our next speaker is Glenn Bandy.

MR. BANDY: I have been asked to say a few words about a program at Texas Instruments that we call the Champion's Program. Mr. Barnes also asked me to explain how the program became established with the University of Arkansas. The way the program got started at Arkansas and a number of other schools, was that a few years ago TI discovered that, like most other companies, we were getting numerous requests for support from universities. In fact, every day I am told, the mail brought in requests from universities for some sort of assistance, and as a result TI decided to form a committee called the University Contributions Committee to screen these requests. This was in late '79 or early 1980. This committee then started reviewing all requests and soon decided to set up a program which they called the Champion's Program to concentrate on a smaller number of schools. This was necessary because we had limited funds to transfer to colleges and universities, and our help could be significant only if fewer schools were selected for our support. The University of Arkansas was one of the schools chosen for the Champion's Program. I happened to be drafted to be the Champion at the University of Arkansas, primarily because I was a graduate of the school.

As a result of this program, TI has gotten involved in such areas as consulting agreements and research, and in providing technical seminars at universities. As an example, at the University of Arkansas, really the only presence that TI had on the campus prior to 1980 was recruiting. We are now active in over a dozen significant areas of interface at this school, involving a large number of TIer's and university personnel and students. Since initiation of the Champion's Program TI has strongly encouraged involvement of selected faculty and universities in the business of TI. This has certainly paid off, I think, in coupling universities to industry. We have increased our summer employment. We have begun to hire summer faculty for the first time. We have begun to share resources, primarily in the integrated circuit area, and I will talk about that a little bit more later. We have signed up at some of these schools on their industrial affiliates program and we encourage not only corporate gifts, but gifts below the corporate level such as through a TI program for matching individual gifts.

I am going to skip several things that I had originally planned to cover, because I think that most of them have been said. Also, I am sure that some will come out in our discussions, but let me summarize some of the things that, in my opinion, industry should do to improve university interactions.

First, I think that one of the most important things is to establish and maintain formal contacts with key university administration and faculty. We have proved over and over again this has paid off. That is the only effective way I know of for us to communicate our needs to you and for you to communicate your needs to us. Second, I think we have to establish more consulting relationships and summer employment with university

staff. We have tried to do that at TI and we have made some progress in the past few years. For example, we seldom saw a university staff member on our payroll in the summer until we started this Champion's Program. Third, we need to increase and broaden our support of university research programs. I know there is a lot of concern on the part of university, or the academic side about the requirements that we impose upon you when we talk about our proprietary rights. Of course, the university researcher is concerned with his right to publish, but I feel we can resolve problems like that. Also, when we sponsor work at the university that carries a DOD classification, then all parties have to make sure that we abide by the restrictions imposed by the DOD. We can resolve these differences too, I believe. Fourth, I think we need to increase funding and/or equipment gifts to update and expand university instructional and research labs. I really feel like that is also one of the fundamental problems that we have. Of course, everybody recognizes that equipment deficiencies are a serious concern, but I do not think you can have good research or give us graduates with more than just a chalk-and-talk exposure to instructional programs unless you have well-equipped labs, and we can help you out. Fifth, I think we need to identify some areas where universities can share company facilities and capital resources. I think this is something that is overlooked by both universities and those of us in industry. Let me give you one example.

We have started a program at TI where we couple to a university in the semi-conductor technology area. On this program students and professors design integrated circuits on campus and we take these designs and process them through our front end facilities at TI. A typical front-end can cost from twenty-five to fifty million dollars or more. Then we send the completed pieces back to the school, where they are cut up and packaged for tests. Later we bring these students and professors down to TI for the summer where they receive further on-the-job type of training. This is a very effective program. We now have it going at four schools; the University of Arkansas, Texas Tech, Texas A&M, where we started the program and where it has been the most successful, and Georgia Tech.

Sixth, this is something else I feel like we are not coupling together well enough on, but we ought to be more available to assist selected universities in the updating of engineering/scientific curriculums and the development of new course material.

Now, to be fair, I have some recommendations for university research administrators.

First, it has been my observation that some schools, and I won't name the names, have probably gotten in more areas of research than they have the economic and staff capabilities to support. In fact, the staff deficiencies in some cases have been more important than funding limitations. I would suggest that you limit your research to a few carefully selected areas and concentrate on becoming more proficient in those that you do select. Second, I do not want to be hit by a big flood of requests here, but I think you ought to seek out more actively industry support in your area of interest. However, you have to be willing to participate to an extent in directed research, because for the most part we must, in order to satisfy our stockholders and those interested in making a profit, concentrate on research activity that has some prospects for turning into a product for us. One that we can build and produce economically.

I think you are well qualified to do some basic research for us, and I believe we can and should get together. Come to us and let us couple your capabilities to our needs, and I think we can work out some good programs. Third, we would ask you to be a little more understanding in helping us to resolve our proprietary rights problems. I think, again, if you will do this, we can for the most part satisfy the desires of your researchers and your graduate students to publish, and we really encourage you to publish. We think it is good for both the university and the research, and it also gives us some publicity, which we would welcome. And finally, I believe that you should recognize, and I believe for the most part that you do, that university research can and should provide for producing better qualified graduates. I think this is the fundamental issue. Research in a university is important just in itself. We agree to that, but for the most part, the purpose of current university research, in my view, also should be to update the caliber and capability of the graduates that you produce, and I believe if you effectively couple students, faculty and renowned researchers into integrated research programs, then that will happen.

Well, those are my comments. If you have any questions later on of the panel, I will be glad to discuss them with you.

MR. BARNES: Thank you Glenn. Our last speaker will be Herb Fusfeld.

MR. FUSFELD: Thank you very much, Dennis.

Well, like I said, I have not found anything that I disagreed with in any of the remarks I have heard this morning. Maybe I can make some that somebody else will disagree with.

We are all conscious of many rapid changes taking place in technology, in the universities, in the relationship, and so on. However, there are also patterns of continuity and trends, which form the foundation of these changes. I would like to put both the changes and continuity into some perspective.

In the following brief remarks, I will describe some unifying themes to try to tie together a number of these changes, particularly the relationship between university and industry, and try to distinguish those items that are truly different today and those that are simply newer forms of older relations.

First of all, let us consider the revolving relations of government and industry which affect the university. It is almost hard to believe that before World War II, industry and private foundations were about the only sources of support for university research. In the early 30's at the request of President Roosevelt, a study was conducted by Karl Compton, then president of MIT, to consider how the federal government could strengthen university research. The study recommended that federal research grants be provided for project scholars, and such a program was implemented by the mid-30s.

It is of continuing interest to note here that there was a very broad and outspoken opposition to this concept by the university community based on the concern that the federal government would have undue influence or even control over the university. When the universities grasped federal

support, university research really took off in the 50s and 60s. The concern took a much sharper form, as it was summarized in 1953, by Clark Kerr, Chancellor of the University of California at that time, who referred to the "federal grant university."

Well, in spite of these concerns, the scientific base strengthened, scientific advances quickened and research universities prospered. During the period of roughly 1950 to 1970, industry was almost an outsider with regard to the mainstream of university research direction and the interest of graduate students. Almost but not quite. The professional schools, engineering, agriculture, medicine, maintained continuing liaison with the relevant industry sector. Chemistry departments pretty much kept up their ties with the chemical industry.

After 1970, the decline in federal funding forced universities to examine their research structure more carefully. Among other things, they rediscovered their link with industry. They did so in the early 70s because they were frightened. They were shocked by the discovery that federal funds might not grow indefinitely. They did so in the middle 1970s, because the career choice of the graduates began to refocus the attention of the universities on their role in economic growth and the technical needs of the private sector. Today, their interest in industry continues to grow because this holds out the potential for improving the universities' financial base and increasing their contribution to society, provided the objectivity and the freedom of action that is essential to universities can be preserved.

Most of the evolution of government and industry roles with regard to support of university research has arrived at a unique and promising stage today. Federal support provides a strong foundation for a university research system that is the envy of every country in the world. There is no possible way that industry funds could have provided the structure of the university research system that has been developed over the past thirty years. It is the necessary support by the federal government which permits the university to have the facility, the personnel, and the technical bases that can contribute to the civilian sector for economic growth. It is this total capability that can be linked to industry through the free choices of the university. There are many issues of public policy that arise from this. The most obvious, of course, is that an individual company may benefit from technical progress made possible by the use of public funds. But of course, there are several responses to this.

One, a company can benefit only if it builds upon university research through substantial investments.

Two, it is the university which has the right to patents and know how arising from government grants and contracts. And the university has both the opportunity and the obligation to negotiate for those commercial uses that will return optimum benefit to the public and to the university.

Three, of course, most importantly of all, society supports university research so that benefits will flow to society. In our form of government and economic system, the conversion of technical advances to useful products or services can only take place through actions of the private sector.

I have touched briefly on the changing government role. Let me talk about the industrial role. Consider the evolution and the realm of industrial research. This sector has grown about as rapidly as government has since World War II. It has grown more rapidly in the last decade. Today, industrial funding for research is more than half of our national research expenditures. This growth in funds, in technical interest and stimulation of economic activity, and its impact on international trade, have all combined to give the system of industrial research a role of critical importance in the modern industrialized world. It seems clear that today industrial research is the principal driving force behind the process of technical change.

Technical development in all sectors is important. The scientific advances at universities will still create revolutions. Nevertheless, the current momentum of science and technology is sustained by pressure from a growing system of industrial research. The implication of this statement is of special interest to our subject. The growth of university-industry interaction, particularly the emphasis on the commercial exploitation, is really part of a more general trend than industrial research. There is today an increase in all forms of linkages that add to the technical resources available to industry. These tend to satisfy the broader technical phase necessary for continuing industrial growth.

Now, let me spell this one out a little bit. I am going to propose a technical analogy of Parkinson's Law, and it goes something like this. Every technical organization which generates science and technology, generates the need for new science and technology at a faster rate.

Therefore, by definition, every technically based company is becoming less self-sufficient. Texas Instruments generates less of the science and technology relative to its needs today than it did ten or twenty years ago. Paradoxically, this is a direct result of the increase in industrial research. We have seen many actions of industry that reflect that. There is a great increase in collective industry research by large technology intensive companies to supplement their internal resources. We are going to hear about some of this from Larry Sumney at lunch. There is a rising intensity of licensing activities, of joint ventures, of private consortia in ocean mining and jet engines. There is a general internationalization of business relationships and of research and development, and also greater university-industry interaction. There is no time to expand further on this theme, although I will be happy to answer questions on the panel or afterward, but instead, I would like to close with some comments.

There is the evolution of the processes in transfer and exploitation of university research. There are indeed many new forms of this transfer process. Certainly, new financial mechanisms which we will hear about, and, of course, technical areas which are the principal focus of today's activity. Nevertheless, none of these require changes in the underlying university research structure, or raise any unusual concern about faculty conflicts of interest.

The emphasis on biotechnology, for example, has certainly resulted in the loss of faculty members to both staff the companies and to start new companies. But this is not greatly different than the semiconductor industry twenty-five years ago, except possibly it happened more quickly with less warning.

There is in fact today a transition period whereby a major scientific advance and the know-how for its application in biotechnology, for example, is emerging from the university, while industry is developing its technical strategies and acquiring personnel, to bring the technology into the marketplace.

Five years from now, the major corporations most concerned will have adequate staff and facilities, and will be generating much of the future advances in biotechnology. This will set a whole new basis for university-industry relations in that area. But there is a final aspect of the university approach to technology transfer, which comes directly to the purposes of this conference. I refer to the emergence of professional staffs at the major research universities concerned with the exploitation of university research as a full-time assignment.

Now, we have come a long way from relying only on outside patent brokers to using part-time administrative staff to full-time patent licensing personnel. Today, even beyond that, there is increasing use of full-time personnel who are responsible for developing the optimum business relationships that will build upon university research, convert it to economic use and provide income to the universities. This kind of reasoning calls for the same criteria that are used in industrial research, and many of those with such responsibilities at universities today, have come and are coming from industry. I believe this is a powerful positive trend. Such a cadre of professionals provides a buffer at the university between research faculty and commercial exploitation. It also offers a contact for industry, which can evaluate the time and investment necessary for converting research into economic use. The university-industry partnership today has a sound structure for future growth, but the key for success lies in the need for realistic expectations. Commercialization will not resolve the financial problems of the university. University research will not ensure industrial growth. However, the process of working together will help both of these. The realm of government is in developing a public policy that generally will encourage and strengthen this process.

Thank you very much.

MR. BARNES: I would like to take the first question, which blends what all of our panelists were talking about. In high technology industries, like TI and many of the biotech companies,which are pushing the technical frontiers on their own, do we run the danger of the universities becoming less a source of intellectual innovation in these areas? Do the universities revert more to what Don Langenberg referred to as the transferers and storers of knowledge rather than the originators?

Now, since this question touches all of you, maybe I will just start left to right, and let each of you address it.

MR. LANGENBERG: I do not foresee a problem there. I think the notion of the research mission of the university is by now so thoroughly accepted by our faculty and our institutions that they will continue to do research. If they continue to do research of the type I think they have been most successful - at so called basic research - then I do not foresee a problem.

Difficulties will arise in those areas where the investment required to put a research university in a position to do research is substantial. Glenn described a possible solution to this in the semiconductor industry, the making available to a university researcher the results of very high capital investments within an industry, not to do the same thing with that facility that the industrial researchers and developers are doing, but do basic research. I think that is potentially one of the most substantial benefits of the industrial-university relationship.

MR. FUSFELD: Well, I think all of the experience shows that as the fields of interest change and as industry becomes more proficient, for example, in the microelectronics field, universities simply move onto something else. There are hundreds of years of background behind us. However, it does remind universities that they may have to be a little faster on their feet and flexible in their ability to follow the possibilities in the fields. The tenure system and the locking in of certain groups that may be twenty or thirty years behind the fashion will be a continuing problem with a fixed amount of money. So, some internal ability to move resources around and make more changes will probably help the universities pursue new frontiers as industry research excels in some fields.

MR. BANDY: I guess I have two comments. One is I do not think all of the university research should be intraconnected. I think universities should plan that some percentage---I don't know what percentage---of their research should not be connected with industry. We look at basic research this way at TI. Certainly not on a 50-50 basis, since most of what we do is applied research or advanced engineering development, but we set aside some of our R&D funds to do those things that don't have to have immediate application or have a low probability of eventual application.

The other point is that in my experience I still don't see industry having a monopoly on the brains. I think there are a lot of brains on the university campus, and maybe more brains per capita there than among us in industry. I know a specific program we are working on right now ---it just happens to be at the University of Arkansas, but there are other universities. On this program we are doing maybe 9/10ths of the work and Arkansas is doing 1/10th, but the creativity required on their part is much greater than it is on our part. They are doing an outstanding job. We are learning from them. We are going to take that knowledge and apply it to other problems at TI.

MR. BARNES: Thank you, gentlemen.

This question, again, I think should be addressed to all panelists. The fears about the federal government's influence on research patterns in universities have been talked about. What can be done to prevent the same thing happening as industry becomes a larger sponsor of university research?

MR. FUSFELD: Well, from what I remember, industry money for university research is less than five percent, and I still am actually floored by the deep concern about that five percent overweighing the other ninety-five. The other ninety-five doesn't all come from the federal government; a great deal comes from state government. But since universities have learned to accommodate and prosper with seventy or eighty percent of the money coming from the federal government, surely they will not worry about the five percent from private industry.

MR. LANGENBERG: One remark; why would you want to prevent that? It seems to me that one of the specific advantages and benefits of industry-university relationship is that the interaction will in fact influence both parties, to their mutual benefit.

MR. BARNES: Good point.

This is a question addressed to Glenn Bandy. Can you give some examples of new technology products introduced by TI resulting from interaction with universities?

MR. BANDY: I guess I can't name any specific products. Of course, we have benefited in the semiconductor part of TI from the work that is being done at Stanford, for example, and some other places. Many of us (I represent the government electronics system group at TI) have certainly benefited from research done in places like MIT. This work is done in labs at MIT, but from both the device and system standpoint, we have benefited tremendously. I anticipate we still will.

MR. BARNES: We have a question addressed to Glenn Bandy and Herbert Fusfeld. Who should own the license for a technical development at the university which was funded by a private sector sponsor; the university or industry? How does a private sector recover its investment, with ownership vested in the university?

MR. BANDY: Well, being a capitalist, of course, I feel like he who puts up the money should get the benefits, ultimately. However, we at TI handle this type of thing on a case-by-case basis. We make up front decisions and reach agreements with the university on what our rights are and what the university's rights are on a specific area of responsive research. You have got to understand, of course, that in some cases we do feel like we have a proprietary right because for the most part our research is fairly well directed.

Now, that is not completely true, because we do put money in what we might call centers for general research where we have no rights to the resources at all. And this is quite often the situation where we will, along with other companies, support some major thrusts. But none of the other participating companies have any specific rights to the research either.

MR. FUSFELD: Let me add a little bit to that. General experience is that patent issues are one of the most annoying and irritating part of the negotiations. There have been very few cases that we have run across where the issues have blocked an agreement from taking place. So it is workable. I think that the answer to both questions lies in the fact that the university is sort of a marketplace of its own. If the conditions are too strict, the company will not give certain amounts of money to them.

In most of the cases, patents are not even a critical issue. We are truly paving new areas where there is a lot of money involved. Of course, the companies expect to have some kind of rights to inventions. If the university won't grant them, then there are other universities who will grant them. If no universities will grant them, then industry will do the research themselves. I can only repeat that the system as it is today, seems to be working well and patents have not actually stopped in any serious way, a company from working with a university where there was a reason for a liaison.

MR. BARNES: Don Langenberg.

MR. LANGENBERG: I would just repeat that universities frequently behave as though they are a voluntary collection of scholars. I would emphasize "voluntary." If the scholars do not like a proposed arrangement with an industry, they won't participate in the arrangement.

MR. BARNES: This one is directed to you Don, and Herbert, you may have something to say on this, too. Since the dean or administrator of a college controls the reward for a faculty member, he or she is a key person in technology transfer.

In choosing the deans at the university should the administration probe the prospective dean on his or her feeling on technology transfer and insist on a positive viewpoint?

MR. LANGENBERG: To be honest, I guess I would have to say that in the dean searches in which I have personally been involved in the last several years that has not been a major element of concern. On the other hand, it has not been totally absent from the discussions. My institution is in the midst of developing an institutional consciousness about industry-university relationships, e.g., because we have been engaged in assisting in the development of the Chicago Technology Park. This has created a considerable amount of interest on the part of faculty and of potential candidates for administrative positions. The subject has come up in interviews. It has not been a major element in these discussions, but I think my answer is that if I get a positive response, I feel much better about the candidate than if I get a negative response.

MR. FUSFELD: Let me answer that in bringing up something that somebody mentioned as one of the major really new developments, namely the accelerating role of local groups, city, region, state, government and so on. The relevance to the question is that I am aware of a number of situations in which I was involved personally, of searches for engineering deans particularly, and for some scientists where one of the major objectives was to help develop economic growth in that region with the university as the base. And a pertinent question raised was whether the candidate, in fact, was in a position to know industry and help initiate that kind of economic development?

MR. BARNES: This will be our last question. It relates to the one we have just discussed. Have the various incentives for research support, things like tax credits, patent ownership, equity positions by universities, been effective or important in motivating industry involvement with universities? In a sense, we are going to comment prospectively on the whole conference for the next three days.

MR. FUSFELD: I will start off and go into something I said. There is a general need in industry for coordinating its technical base. Now, I spent twenty-five years in industry and I keep in close touch with most of my colleagues who are senior technical executives of the companies. I do not remember any time previously when they had so much of either their own personal time or of their staff working on a variety of linkages, talking with other companies, around the world. There is simply such a growth of technology every where in the world at every institution, that more and more is going on outside their own domestic laboratories. So they are very anxious to keep in touch with

that. Therefore, that is the driving force, not necessarily any single incentive. I do not know of a correlation between a single action, such as a tax write off or incentives to work at universities or a patent arrangement at universities. Nothing that I know of correlates with any increase in changes of the action that they wouldn't have taken anyway for other reasons.

MR. BARNES: Don?

MR. LANGENBERG: From the university point of view, I believe that these incentives are not major motivating factors. One motivating factor, of course, is money: support for research, support for faculty, support for graduate students. That is important money if it comes from industry, because although it may not be anymore flexible than federal funds, it has different constraints on it, and together that may increase flexibility. But even then money, I think isn't the primary driving force.

I think what is really driving university people who are interested in enhancing connection with industry is that they have discovered lots of important and exciting things are going on outside the ivory tower. Most basic research is performed in universities, but most total research, basic and applied, is performed by industry. There are important things there.

There is also important political support to be had from the increased recognition that universities are, assisting in the economic development of their areas, of their states, and the nation. I don't think money is the primary driving urge, and I don't think that the incentives, at least on the university side, have been a major influence.

MR. BARNES: Mr. Bandy?

MR. BANDY: I have two or three comments. I guess one is I do feel these incentives are effective and we would like to see them enhanced. I think we could do a better job of supporting university research and teaching. For example, one that has been improved in the last two or three years particularly effects those of us who build equipment---computers and that sort of thing---that could be used in university research and instructional labs. It is a substantial incentive to provide that equipment to you.

On the other hand, another incentive for a company to increase its R&D is about to be written off the books. The law was passed two or three years ago in a great move to stimulate the economy, where you get a tax credit for a certain percentage of the growth that you show from year to year in the R&D area. This is about to expire and that will hurt us, and hurt you.

MR. BARNES: I would like to thank Don Langenberg, Herbert Fusfeld, and Glenn Bandy for helping us to this conference started on a good note.

Thank you.

SESSION II

INDUSTRY ACCESS TO UNIVERSITY TECHNOLOGY
PROSPECT AND PROBLEMS

MR. DUMMER: I think we are ready to start Session 2.

Session 2, Industry Access to University Technology - Prospects and Problems, in a sense will set the stage for many of the sessions which follow.

It examines the question of how does one access the university as a source of new technology and as the cutting edge of scientific knowledge? What means of access and what relationships are appropriate for large companies and for small companies in response to investment company initiatives and in cooperation the state and regional economic development efforts? What barriers have to be overcome? How does one match interests or find the right scientist in the right university?

It is my pleasure to turn this over to the moderator, Earl Cilley, Director of Sponsored Projects, Stanford University.

MR. CILLEY: Thank you, George, and good morning. Welcome to the Second Panel session of the conference. I am Earl Cilley, Director of Stanford's Sponsored Projects Office. I am pleased to get us underway on the second panel.

Following on the subject of the first panel, our assignment is to discuss the reality of industry access in order to turn it to a practical use and how to facilitate that process.

One of the major university and technology access challenges is an array of what I call cultural barriers. Universities and the private sector have very different institutional priorities. Surmounting those can be a vexing and time consuming proposition for both parties.

Our first speaker this morning is Thomas Tolbert, Director of External Research and Development from Monsanto Company, who will lead off our discussion. He and Monsanto have a lot of experience dealing with universities, and Tom will share with us this morning some pet receipts for surmounting those cultural barriers from his personal collection of successful ones. Thank you and join me in welcoming this morning, Tom Tolbert.

MR. TOLBERT: Good morning. Overcoming cultural barriers may seem an odd topic for a discussion on research cooperation between industry and universities. I think this is the first talk I ever gave on a sociological theme, and it very likely will be the last. After all, we live and operate largely in the same country. Contracts are a part of our everyday life in industry, and collaborations among faculty are very common.

Our experience, though, at Monsanto, is that industrial investigators and faculty approach such cooperation in very different ways using very different premises, and that is often overlooked. We do operate in different environments, very different cultures, if you will.

Moreover, universities vary widely in their approach, just as different segments of industry vary. These differences certainly do not preclude us working together. However, to be effective in a joint program, requires that differences in approach be mutually understood and criteria for interaction be established at the outset.

Monsanto has enjoyed extensive interaction with academe using a variety of protocols. Some of these approaches have worked better than others, and we have learned with experience. In our view, the primary requirement for effective collaboration between industry and universities is that each partner understand and respect the role, goals and operating practices, i.e., the culture, of the other. This is especially true if interaction is to continue over a period of years. To do otherwise invites misunderstanding, transfer of incomplete data and bad feeling, perhaps even litigation.

Although it may sound unduly legalistic, especially to some university participants, there are a number of perfectly legitimate questions which should be considered by both partners at the outset. Among these are such issues as:

"What's in it for each partner and how is this to be protected?"

"How long is the period of cooperation to be? How can it be extended and how might it be terminated early by either partner?"

"What is equity in the sharing of resources and results? Who owes what to whom?"

"What are the rights and the responsibilities of each participant?"

I would submit that effective collaboration over an extended period is highly unlikely unless each partner considers these issues and shares their expectations. Many, if not most, incidents of frustration or bad feelings in industry-university programs are traceable to failure to clarify these concerns in the relationship.

There is a very real tendency in establishing a new program to assume that the answers are already known, and to operate on that assumption. We all know what normal practice is in our own organizations and how we have handled things in previous programs. It is easy to forget that business protocols are not necessarily those of academe and vice versa. We forget that what is acceptable and expected in one environment doesn't necessarily hold in the other.

To me, this is best exemplified by the varieties of ways in which grants and checks must be made out for what industry might consider very straight forward research support. For instance, if you follow the pattern that the University of California has set for itself, other universities aren't going to know how, or want to handle the award of support in the same way.

Fortunately, the level of mutual understanding between industry and academe is increasing, in part due to the efforts of organizations, like NCURA, and the presence of a number of meetings of this type. In our observation, at least, it is much easier now to establish new programs than it was even five years ago. Our sophistication in such endeavors has increased and interaction facilitated internally by a growing level of confidence in Monsanto that the university resource can be utilized in a mutually beneficial way. As a result, we now participate in some way with research efforts on more than fifty campuses.

University administrators and faculty also have gained more experience in working with industry, of course, and seem to have a much clearer idea of what is appropriate for their campuses and what is not. My impression is that they, too, find it easier and more "socially acceptable" to work with industry. Certainly, the number of successful interactions between industries and universities, which have been publicized, have helped increase confidence on campus that arrangements can be worked out in which academic standards are maintained and freedoms protected, while still meeting the needs of the industrial partner.

As indicated by earlier speakers, the benefits of interaction between industry and universities are clear. Partnership with academe promises industry assistance or solution to many of our ongoing problems. Where mutually appropriate, there are opportunities for technical support and access to specialized expertise needed in solving specific problems. Help is available with the continuing issue of how to deal with providing career-long training for our technical personnel. In addition, there is the very real benefit of identifying high-potential future employees among students and post-doctoral people involved in these interactions. Finally, and perhaps most valuable to large industry, is the opportunity to gain early insight into new developments in a variety of new fields. None of us can cover all of the future opportunities ourselves. Working together will give us the opportunity to do so.

In turn, industrial collaborations can provide to the university and to its faculty support for research, access to specialized facilities, insight into current commercial questions and longer term trends, consulting opportunities, and jobs for the university's most visible product, its students.

One might assume at this point that, with twenty years of experience with university people, Monsanto should be able to provide a firm set of rules, or perhaps even a recipe for establishing successful collaborations in academe. In fact, the situation is quite the opposite. In our view, there is no single approach or set of rules, no absolutes, which can guarantee success or even an amicable relationship. This is part of the risk. Moreover, I would hold that to even insist on a firm protocol, will deny you a number of opportunities to the detriment of both sides.

We can, however, cite some general approaches to a good relationship. These together with a spirit of goodwill and flexibility by both partners will provide the basis needed for working out a reasonble and equitable agreement.

This may sound, perhaps, a little bit too good to be true, but, in fact, a spirit of goodwill and flexibility by both partners will provide the basis needed for working out a reasonable and equitable agreement. With this start, odds for success are measurably improved. So let me touch on some of these.

Primary to the success of cooperative work is that the unique role and needs, as well as expectations, of each partner must be understood at the outset. This requires, among other things, that those involved know each other well enough to communicate. This is a must, since without it a climate of mutual trust and confidence is not possible. How well people should get to know each other in advance depends on the nature of the program sought or proposed. This is one of the reasons that sizeable programs are almost always preceded by some sort of preliminary project or grant.

Collaborations, as opposed to simple research grants to faculty or service contracts, require one thing further; an advance understanding of individual responsibilities. Ideally, collaborations should be based on symmetry of technical contribution, responsibility, and reward.

Perhaps the most obvious issue for contention, and one of great sensitivity on both sides, is how rights to resulting discoveries and new information are to be protected. This requires a trade off between security for patent purposes and the right to publish. Some arrangements must be made to satisfy both needs. There are a variety of formulas for doing so. The overriding consideration, is that both parties keep in mind the importance of intellectual exchange among investigators in furthering progress, and that both consider the ultimate right of the university investigator to publish as unchallengeable.

Some mechanism should be utilized in large programs to avoid divisiveness among participants. There is another very controversial issue, and perhaps everyone has a different approach. Ideally, a research agreement should be between institutions, rather than individuals. This helps avoid the kind of distortion and disruption that sometimes happens when one individual receives extensive royalties or support which are not available to his colleagues. In the practical world, such an arrangement probably is not possible at some universities. It is a very workable solution where it is.

Further, we advise anyone who is contemplating a major research agreement to make sure that it is a real partnership. A company cannot expect success in this kind of relationship unless it has in-house skills in the particular area of the agreement which compliment those of its partner. This should be a relationship of equals and there has to be a means for transferring results. There must be people on both sides of the agreement.

Finally there is the question of scientific credibility and the need for scientific review, particularly in establishing programs that will go beyond several years. Peer review is by no means new to the scientific establishment, and we feel that it is quite properly a part of any extended university-industry collaboration. Strong endorsement by outside experts ensures both parties that the program is progressing as it should.

As a closing comment, it might have been better in retrospect to speak of avoiding, rather than overcoming, cultural barriers between industry and universities. While certainly there are differences in the way industry and academe operate, these become barriers only when an attempt is made to force one into the mode of the other. The value in working together, and a strength, lies in the fact that we are different and our scientists do operate in a different environment.

None of us question the ability of the academic scientist and engineer to do fundamental research or the ability of their peers in industry to apply the results of that research. Recognizing that maximum benefit to each, to society, and to our nation is achieved only when these strengths are combined, then it makes sense for us to cooperate and avoid cultural barriers.

Thank you.

MR. CILLEY: Thank you, Tom.

Second on our panel is Harvard Hill, Jr., President of Criterion Investments. Mr. Hill will share with us this morning his views on how best to apply capital to technology from the investor's point of view. Harvard.

MR. HILL: Thank you. It is a pleasure to be here. We are located in Houston. We manage nine billion dollars in institutional funds. We have several different venture capital partnerships that invest in private companies.

What I would like to share with you in the next few minutes is a process of technology transfer. In our terminology we would refer to that as capital formation. So if you can, just for a few moments, think about this whole process of technology transfer being one of capital formation.

Figure 1 provides some of the data that I think is important to look at when you look at this whole process of the capital that will fund different research projects.

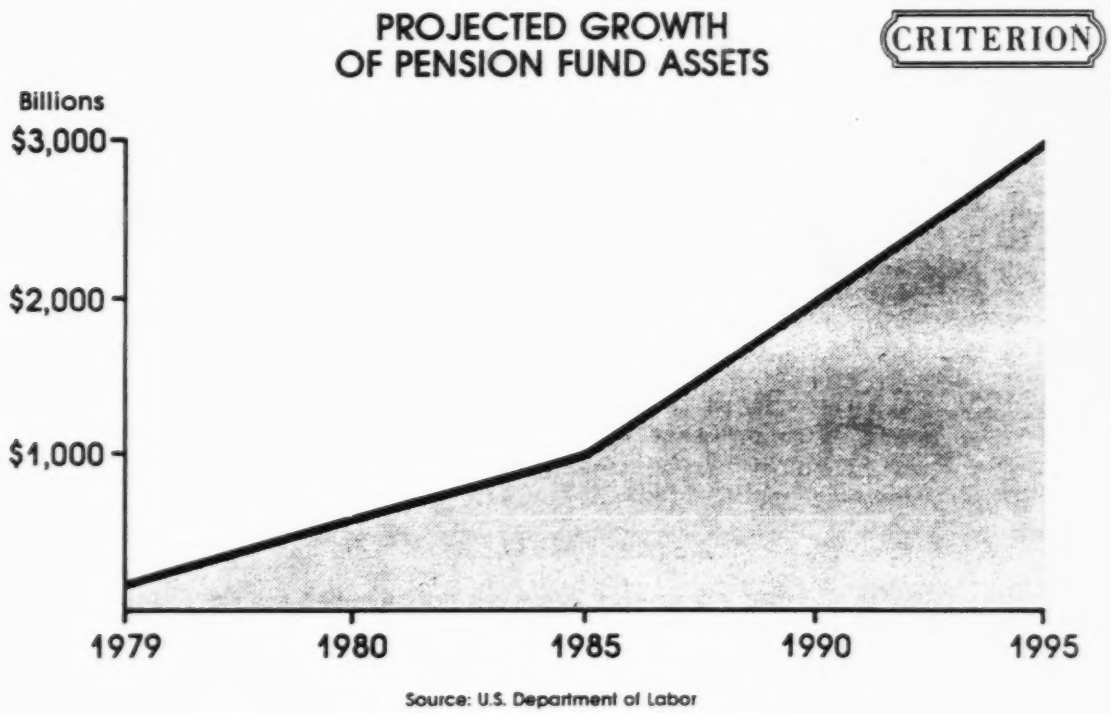


Figure 1

In the United States today, most of the capital that comes to private industry and to the private transaction sector is coming from pension funds. This is just an illustration of what is happening to the growth of that pension fund pool of capital. In the last five or six years when we saw a reduction of capital gains from a tax rate of forty-nine percent down to twenty percent, you saw a tremendous amount of money flowing into venture capital partnerships. This also is an illustration of that growth that is projected for the next ten years. By the year 1995, the sum of money in pension funds will quadruple. Today we have about $850 billion growing at approximately twenty percent annually.

Figure 2 is an illustration of where money is allocated and the source. This illustrates that about a third of the money that goes into venture type capital investments is from pension funds. Corporations represent about fifteen percent and individuals and insurance companies about fourteen percent each.

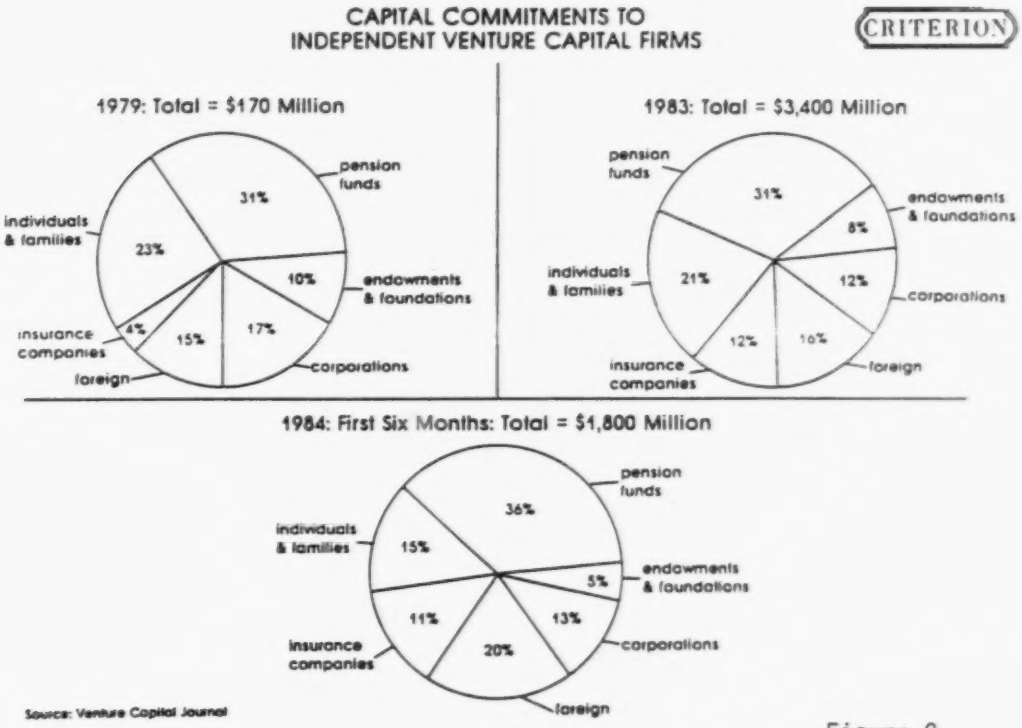


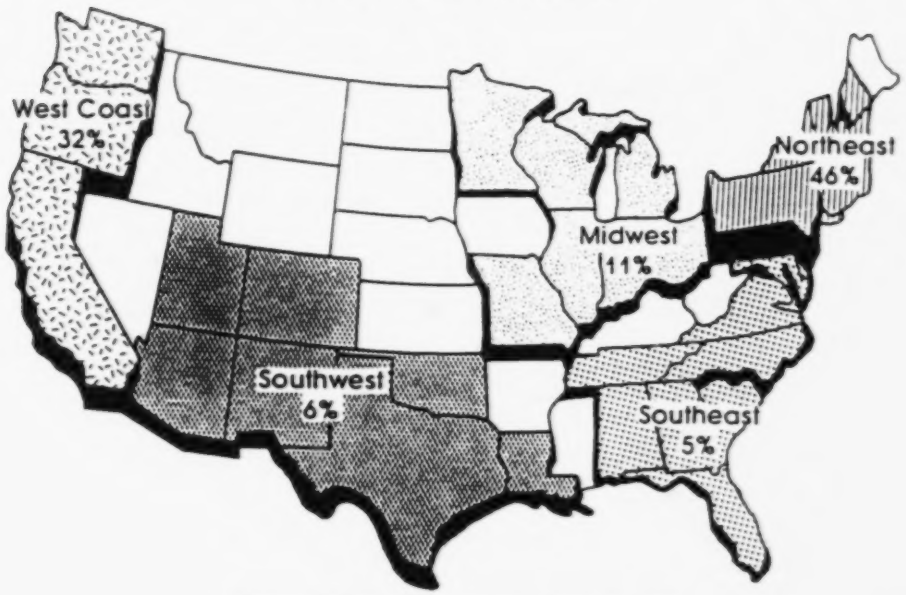
Figure 2.

Figure 3 shows where capital is raised in the United States. It goes into private funding, and you can see about fifty percent of the capital of the United States is raised in the northeastern sector. You can see the allocation of that capital and where it is raised in other parts of the country.

Figure 4 is a map showing where the capital is spent, or where it is invested. You can see that those figures in the Southeast and the Southwest and the West Coast are just about double those from the prior map. Also, in the Northeast on the first map, you saw fifty percent of the capital was raised in that area, yet only thirty-one percent of it is invested or spent in the Northeast.

GEOGRAPHICAL DISTRIBUTION OF VENTURE CAPITAL RESOURCES

CRITERION

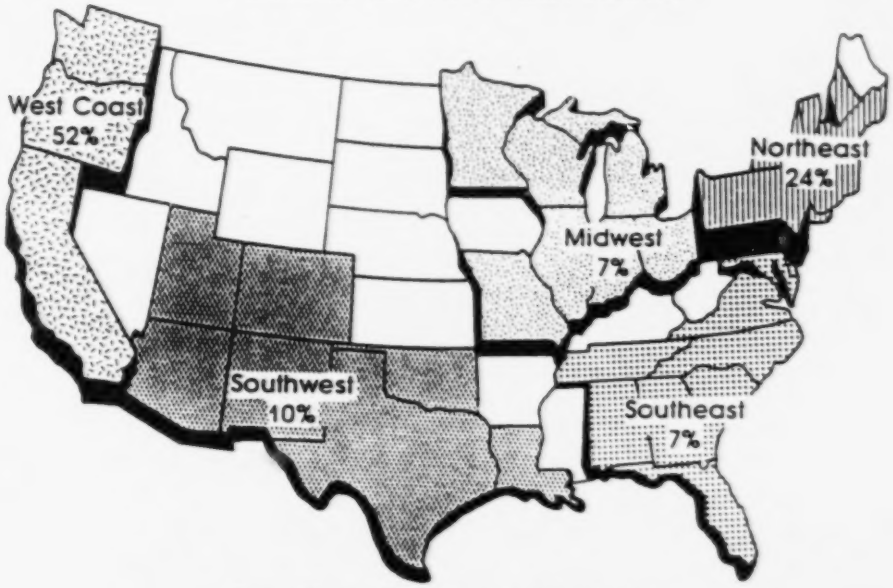


Source: Venture Capital Journal, Figures for 1983

Figure 3.

GEOGRAPHICAL DISTRIBUTION OF VENTURE CAPITAL FINANCING

CRITERION



Source: Venture Capital Journal, Figures for 1983

Figure 4.

I want to give you just a real quick background, if you will, on where capital is in the United States and where it is coming into the private sector; because, in my business, what we do is invest in private companies. We take this capital from pension funds and put it into private companies, and if you are looking at how to transfer technology from the university into the private sector, I think that it is critical to understand the full process of capital formation.

The sources of funding, obviously, are the foundations. They are from individuals, from research and development partnerships. Also, on a longer term basis, the capital funding is from venture capital groups; it's from investment banking groups; it's from commerical banks. I think if you want to take research out to infinity and take it to a point that it returns something to the creator or the user, then you need to think about permanent forms of financing. That's when we utilize the full process of capital formation.

Every significant research center and academic center of the United States, has contributed to the technology transfer of research or the capital formation of research. As examples, consider the following: In the middle of California an area, often referred to as the Silicon Valley, was created years ago with Stanford University and Stanford Research International, (SRI). On the East Coast we have Duke University and Research Triangle Park. In the center part of the Sun Belt and Texas, Microelectronics and Computer Technology Corporation (MCC) has located in Austin near the University of Texas. These are examples of research centers combined with academic centers. I think the process of creating technology transfer comes from both the research center and the academic center, and how they access funding on a permanent basis.

What I would like to do next, is to give to each of the universities two requirements that I believe would facilitate this process and create capital formation for technology transfer. Also, I would like to give you three methods of implementing those requirements.

I think it is critical that you take technology and have it funded properly, because it is significant to the university. It means a lot to the party that creates that function. It could mean a lot to the faculty research group, not to mention what it means to the private sector in the business community who will be looking for a return on their investment for their shareholders.

I think the critical and first requirement of the university is to determine a method to deliver technology and create the method that can get the technology funded, either through public foundations or partnerships. I think there has to be an incentive to the research center of the university.

I see a lot of projects. We work with a lot of different universities and research centers, and we see them done in many different ways. Where a university or research center is providing the research basis, (e.g. individuals doing the research, the overhead, the historic substance and protocol for doing this type of research), I personally think that type of instituion requires sixty percent of the royalty income, or sixty percent of whatever the equity value is at that given point in time in the technology, and I am talking about a period of time here where we are talking about direct research. I think that the other forty percent can go to those furnishing the funds.

I think once the vehicle, or the project, or the research, or the equipment has gone through the phase where it has gone beyond direct research and it has proven that it has commercial value, then I think it takes on a different type of sharing interest, and I think you can almost reverse that original sixty-forty percent. I think the share of equity or the capital, that goes to the private sector might very well be as much as sixty percent with forty percent going to the sponsoring university, the partner, or the research center.

I think those are just blueprints. They can be changed, I think, five, six, or seven percentage points either way. Those are definitive guidelines. Once you find yourself looking at projects where you are fifty-fifty, or seventy-thirty, or eighty-twenty, then I don't think they are in the realm of reality that gives a good response back to the university or to the research team. After all, if it was done properly, then there is no reason not to expect the university's partner to implement it and improve it as the years go on.

We think that if this type of a project were started today and a research center or university had not done this before, then in a few years, by the year 1990, you would have made a significant contribution to overhead.

The other requirement that I would place on a research center, or university, would be to create a vehicle to deliver the product; in other words, create a delivery system. Just because you have funding doesn't mean you have a delivery system for the products or a technique, or wherever the research is going, to create the transfer. I think the product system is very important. I think what that means is that you are associated with the marketplace--international skill that can take that service or product and cause it to happen (e.g. to create sales, to create revenues on a national, or regional basis). We can take those sales and put the revenue back into the university research. It is critically important that we not only get the project funded properly and out of the research center or the university, but secondly, that we feel like once we have funded it that we have created a product delivery system; a delivery system that will enhance revenues for that particular project. In doing that, I would say that the same type of guidelines, the sixty-forty percent guidelines, generally should prevail. Those are just starting points.

I think that as a sponsoring university or research center, you have a right during the period of direct research, of claiming approximately sixty percent of that revenue source that might be generated. After the product has reached commercial value, then I think it is a different type of entity. You might very well go from a research developer partnership into a corporation for profit. That may be the transition that facilitates the capital transformation process. I think you need to have a different sharing arrangement.

I would say one thing that appears to me to be on the horizon over the next three, four or five years is that faculty researchers are going to require, or they will seek, regular definition in this relationship inclusive of direct compensation. I think a university center or research facility needs to address that problem up front now. I think that you will find that people on your campus or in your research facility are going to be looking at their participation in the business venture. I think that is one of the things that we may as well face up front so that we can maintain people within the university and research center.

If I may speak just briefly about the implementation process, I think there are three areas that a university or research center can focus on in implementing this whole process. The first is what I found to be effective in the work that we have done with different research centers at different universities. That is some type of an agreement that is contractual on both sides. An example of the implementation of this would be the Texas Medical Center in Houston. For some of you who are not aware of this center, it is one of the major medical complexes in the United States. It has 355 acres, some 29 different institutions, some 11 different teaching universities, colleges and schools and about nine thousand students and six thousand employees. It is one of the most sophisticated complexes in this part of the country, if not the United States, perhaps even internationally. Texas Medical Center is in the process of doing "teaming agreements". Another private corporation that is doing teaming agreements is McDonnell Douglas with Johnson & Johnson to use the space shuttle. Teaming agreements are beneficial and I think that it is a way of contracting a relationship between either a university or research center and someone in the corporate world that is going to provide you with capital and/or hopefully the private delivery system which is very important.

Also, I would mention that it would be a good idea to become involved with an association of local venture capital. For example, in Houston, I formed a Houston venture capital association and at present we have twenty-four different partnerships or companies that represent about thirty-seven different individual partners. That represents about two hundred million dollars' worth of capital and about twice that in other capital coming from families, individuals and some corporate entities. Such a large capital base may also exist in your geographical area, and I would commend you to expose yourself to it.

The second thing I think that can happen in the implementation processes of technology transfer or capital formation is to create a research center on your campus that the private sector can come to, to find out what you are doing; to find out what projects you are working on; whether or not it is applied research or direct research; or whether or not it is in the stage of receiving commercial funding. Venture capitalists will want to get involved early in the process and would like to see how you are developing and how you are moving products from those different stages of research to the point that they reach a position of being commercially funded. This can be done through a lot of different ways.

There is one university here in Texas that has created a School of Entrepreneurship. They receive and review about 250 business plans a year. The universities associated with the Texas Medical Center each have twenty to thirty different research projects that they are working on. We in the venture capital business are entering into those projects and we would like to see a research center on that Texas Medical Center campus, just so we will know what is happening. We have a consultant who is on that campus who advises us on what research projects are moving through different stages.

The third thing that I think will make a lot of sense is to communicate what you are doing. There are a lot of people in my business who want to know what you are doing. The investment bankers want to know what you are doing. The commercial bankers want to know what you are doing. The venture capitalists

want to know what you are doing. If you are looking for funding for your projects, there is probably not more than fifty entities that you would have in your own geographical area that need to be notified on what you are doing. The commercial banks, the small investment bankers, the regional investment bankers, the venture capitalists, there are probably some large families and probably some corporations geographically that want to be involved in your project. Even in a large metropolitan area, you probably wouldn't have more than fifty people that really need to be apprised on what research you are doing so that when it comes time to make that transfer, to creat that capital formation, it could be done.

Those are some of the things that hit me as I look at this whole process of doing technology transfer, and in my terminology I would call that capital formation. Speaking from the private funding sector, we would say we are interested in causing research to be funded when it creates a return to the research center, whether that be at a university or a research complex.

Thank you for your time and I look forward to your questions.

MR. CILLEY: Thank you.

There is the occasion where new technology from university laboratories can be readily incorporated into a marketable result.

Our third panelist this afternoon is Mr. Wim Selders, Executive Vice-President of TEC, Inc., General Manager for its peripheral group, and he is responsible for new products development.

Wim is from a small electronics industry company and he will share with you this morning his insights on small business's post-transfer support requirements; what they look for in this area; and when they contemplate taking on licensed technologies from universities. Wim.

MR. SELDERS: Thank you. Good morning.

As Earl was saying, I am with a small high-tech company called TEC, headquartered in Tucson, Arizona. Like Monsanto, you probably nevery heard of us, so Figure 1 presents a short summary of TEC which will have you some idea of what we do.

Fortunately, we are so small that I could put everything on one page and you can read it all in ten seconds. Now, that is small. But we are profitable. Incidentally, the majority of TEC sales are shipped to Fortune 500 companies. My part of the program today deals with university inventions that have been reduced to practice, and that are believed to have commercial value.

We at TEC have the opportunity to evaluate new university technologies, with which we had no prior involvement. We had not been a sponsor or anything like that. We had evaluated those for the purpose of taking an exclusive license to transfer, manufacture, and market. In the process, we ran across some ideas that in general we believe will help remove cultural barriers and maximize the effectiveness between the university or its licensing organization, and a small company. Again, my examples are for technology transfer to a small company which has had no prior knowledge of the invention.

TEC, Incorporated

TUCSON, ARIZONA

FOUNDED IN 1958	
STOCK TRADED ON AMEX	
ANNUAL SALES:	$15–20 MILLION
EMPLOYEES:	400
MANUFACTURER OF:	• VIDEO DISPLAY TERMINALS • DATA PANEL® Switch Assemblies • INDICATOR LIGHTS • SWITCHES AND READOUTS
SUBCONTRACTOR	
BUILDINGS:	150,000 SQ. FT. ON 27.5 ACRES
CUSTOMERS:	OEM'S AND LARGE END–USERS

Figure 1.

First then, we have to define what is small and what is large. This is most conveniently done on the basis of annual revenue. Usually in most companies the amount of annual sales determines whether an industrial company is small or large. I have a suspicion that that is what the organizers of this conference had in mind when they talked about large and small companies, although I am not sure because they did not define it this way. Therefore, I can take the liberty of giving you another definition not so commonly used. Namely, larger companies have larger brains and smaller companies have smaller brains. That is what large companies think anyway, so why should I not admit to it. Besides being from a small company, it gives me the latitude of saying things that people from large companies can't get away with. This indication of large-small is based on the capacity of internal brain power, which is either sufficient, as in a large company, or insufficient, as in a small company, to deal effectively and in a timely manner with complex and important issues concerning the marketability, profitability, investments, and the risk of taking on a new university developed technology. This shortage of brain power only deals with the evaluation of the technology up front. It does not deal with the ability of the small company to successfully develop and market the technology.

Now, what does this all mean? This means that a large company doesn't need the smarts; the support from the university; and/or the licensing organizations. On the other hand, small companies cannot be successful without the full support from the university and/or the licensing organizations. The message is really don't treat a small company like you would a large company. Now, let us find out why.

Figure 2 is a simple illustration of the differences in brain capacity between large and small companies.

SOME DIFFERENCES IN

BRAINS CAPACITY

	COMPANY	
	LARGE	SMALL
PATENT ATTORNEYS	X	
MARKET RESEARCHERS	X	
CORPORATE STRATEGISTS	X	
FINANCIAL ANALYSTS	X	
TECHNICAL EVALUATORS	X	X
EXPERIENCED, TRUSTED CONSULTANTS	X	
MANAGEMENT	X	X

Figure 2.

When you search out large companies for the new venture, these large companies put their corporate patent attorneys on the projects, who are pretty much capable of making sure there are no infringements. The small company has no patent attorney on board, and they probably don't even know what a patent attorney looks like, nor do they have the time to recruit one. The small company would prefer it if they could work directly with the faculty experts that have already done the work for the university or the licensing organization. Also, a large company has an army of market researchers who have the time to fully research relative market data. A small company may not have a market researcher at all, and if they have one, he or she is probably a generalist who most likely knows little about the particular subject, and who would have to spend much more time than is available to get a complete analysis. What they need is the assistance of the university and the licensing organization, who have done the job, or should have done the job already. The small company could go to a consultant, but how do they select one on a short term who they can trust? There can be some awfully big decisions involved which can be very unpleasant if they turn sour for the small company. As you can see, a large company is also better equipped with corporate strategies and financial analyses.

In summary, a small company does not have enough capability to properly evaluate a commercial opportunity or a new technology that they are not totally familiar with, which is usually the case. So then, the question comes up: Why bother with small companies who lack enough brains to evaluate technology on time? Well, because it will pay off. In general, the small company is more flexible, it reacts faster, it gives more visibility, and once committed it is more dedicated. In this sense, a small company has more incentive, because there is greater marginal impact, which ensures that the top executives of a small company are going to be involved. A small company may give stock in addition to a normal royalty. I know that universities get nervous about taking stock positions. I don't know whether these concerns are well founded. As a European, I feel that owning stock is the American way, and as long as the universities don't get involved in running the companies, there really should be no negative elements involved. Also, the small companies' stock is elastic with respect to the success of the technology; much more so than it would be with a large company. The bottom line is that the financial reward of dealing with a small company could be significantly higher than with a large company. The main question is then how should universities deal with a small company?

When a university or a licensing organization has found a small company with excellent capabilities in design, manufacuturing, sales, and management, which is willing to put forward planning and financing for the project then, the university and the licensing organization should immediately strive to gain the trust of the small company. They should be totally frank about the positive, and especially about the not so positive, aspects of the invention, and should disclose any relevant, technical, commercial, financial or political issues. Hide nothing! Get all of the cards on the table.

Next, all the parties, the university, the licensing organizations, and small business companies should develop a program where they work mutually together, each using its specialty to investigate all of the issues that are important for the success of the invention. For those universities that are getting nervous about getting involved in these things, a licensing organization would be an excellent source to take all of these things out of their hands.

Next, the university or licensing organization should be prepared to offer license terms which avoid possible conflicts with the small company. For example, requiring minimum royalty payments may take the incentive away from a small company. If you say, here small company if you win, we win; but if you lose, we still win, you immediately break the trust. Under this type of you win I win; you lose I win anyway contract the university and the licensing organization representatives, in the eyes of the small company, become salesmen. Who wants to rely on salesmen when you are making a major investment? In general, the small company is more likely to trust organizations who don't gain when they lose.

Once the contract has been signed with the small company, you can leave them alone. You can be assured that with the trust that you have developed already, the small company will see you anytime there is a need.

Also, the contract between the university or the licensing organization and the small company, should be worded so that there are no legal or other risks to the university. The only risk that the university should have is that if the

invention would not be successful, it may not get any money out of it. However, if it is successful, the university may be involved with a company that could become a new Apple Corporation. Not so long ago, Apple was small, too.

I realize that not all universities may be structured to give the support I am talking about, but again, licensing organizations can be an excellent source of support for both universities and small companies. In summary, I believe that you could benefit from dealing with small companies. I believe also that I have had given you a roadmap for success in dealing with them.

MR. CILLEY: Thank you. That was a very interesting presentation.

Rounding out our presentation this morning, is Mr. David L. Keaton, Director, Technology and Innovation Management Center, SRI International. David will share with you how universities fit into rational planning for area economic revitalization programs where new technology and specialized training are requirements. David.

MR. KEATON: Thank you, Earl, and good morning.

I also want to talk about technology transfer, but I want to emphasize this in a manufacturing environment. I want to talk about a case study which our group recently completed for the Greater Cincinnati Chamber of Commerce, which really involved a need for revitalization in a major city in the country. One of the potential solutions was the tying together the efforts of industry, university and government to meet the need. This is a little different definition of technology transfer from what Harvard was saying. What I will be talking about here is where the university R&D person works directly with an industry R&D person, or application engineer, and that, I think, is where the greatest technology transfers take place, if it takes place at all.

On August 27, 1984, the Wall Street Journal reported on a study that was completed by Cincinnati. What Cincinnati had done was to establish a new Institute of Advanced Manufacturing Sciences that "will make companies more efficient and productive by helping them to apply the newest technologies, such as robotics, CAD/CAM and computer controls, to operations in product development." This institute will be run by the University of Cincinnati, but they will have a management contract with Battelle.

Let me provide some information about technology innovation. The process of technological innovation involves the creation, the design, the production, and the commercial use of new technological projects and processes. All aspects of this innovation prospect are based on knowledge developed by basic scientific research. Although the U.S. invents more technologies than any other country through basic research, there is growing evidence that there is a lag in translating this new knowledge into commercial success. This appears to be especially true for manufacturing and process technologies.

There appears to be a gap between the development of scientific knowledge and its application in commercial products and processes. The size of this gap is inversely related to the ability of industrial nations to maintain their competitiveness in the world marketplace. Although excellent research resources helps maintain U.S. leadership in the scientific community, it is the translation and application of these results into commercially useful technologies that

will allow the United States to maintain and build upon its overall competitive advantage over the rest of the world. This is especially true in the area of manufacturing since manufacturing is what provides the critical edge in a marketplace that is placing greater value on high quality, low price products.

As a matter of fact, work is being done right now for the Commission on Productivity in two areas; how to shorten the time between basic R&D and adoption of the manufacturing process, and how to better ensure the adoption of the new technologies to the manufacturing environment.

There are a number of reasons that have been suggested for this gap between the development and applications of new technologies in manufacturing. These include cultural and motivational differences among scientists, engineers and businesmen. The differences in motivation, rewards and goals among scientists, engineers, and businessmen have limited the flow of communications among these groups. This has, in turn, increased the time delay in the transfer of new knowledge from the researcher to the applications engineer and then to the businessman who knows the market needs. There is certainly a management shortsided issue.

The present structure of management rewards in the overall structure of the capital markets have acted to limit the decision-making horizons of managers. This has resulted in less investment in corporate projects that may take a long time to develop and may utilize new technologies.

Another one, particulary in manufacturing, which is really a problem, is "equipment cost" in existing capital facilities. Quite often the introduction of new products utilizing new technologies makes existing capital equipment obsolete. Managers have little incentive to invest in new equipment if the cost of such equipment is high and replaces a large portion of their existing equipment. This leads towards more risk-adverse decision-making.

Another problem is the availability of investment capital. The present nature of the capital market encourages investments that have short payback periods, or are part of the investment package that the market currently favors. This leaves little capital for less glamorous projects.

What about university-industry relationships? It has always been difficult for the academic community to develop long-term, strong relationships with industry. Concerns on each side have contributed to this, including the short-term R&D needs of industry versus long-term orientation of academic research and in publication of results for peer review versus proprietary results demanded by industry.

There are a number of existing mechanisms which attempt to encourage the application of new technologies in manufacturing. Many of these you know, such as the university-industry cooperative research centers, such as MIT, and the laboratory for manufacturing and productivity, technology transfer institutes, such as Michigan's Industrial Technology Institute, and Iowa's Center for Industrial Research Services. The federal laboratories also are becoming involved in technology commercialization. Some examples include Oak Ridge National Laboratory and the Tennessee Technology Foundation and Los Alamos and the New Mexico Technology Initiative. The NSF Engineering Research Centers and collaborative corporate efforts such as the Microelectronics and Computer Technology Corporation (MCC), are other examples of cooperative university-industry relationships.

Some new models are apparently being talked about and promoted for the application of new technologies in manufacturing, and some that have been suggested is the investurial extension service, modeled after the agricultural extension model. This service would transfer technology for universities to potential industrial users through designated exchange agents.

Another one currently being talked about is the university-federal laboratory-corporate consortium. This approach would involve linking federal labs, research universities and corporations through joint R&D applications efforts in specific industry areas. A portion of federal lab budgets could be redirected to an innovation fund to help support these efforts in cooperation with industry.

A third one, and one that I think is a lot more popular, is really corporate-sponsored intermediary institutions. Within specific industries, corporations would jointly sponsor R&D applications from institutes which would promote the transfer of new technologies to industry. These industry efforts could be encouraged with federal matching grants. But we are really talking about an intermediary institution rather than the university, itself. What is the role of the intermediary institution? It is really one that is providing a mechanism to bridge the gap between raw ideas originating from university research and, hopefully, the know-how and expertise of the industry necessary to transfer these into practical applications. The model awaits further development.

Very quickly, then, in looking at Cincinnati as my example, The Greater Cincinnati Chamber of Commerce is interested in an assessment of what to do for economic revitalization in an old mining city. Two initial objectives were to assess the attractiveness of Cincinnati for advanced-technology companies, and to upgrade the existing industrial base through greater technology transfer.

Basically, with high technology, there is a high level of innovation and new technologies result in new products and services. It certainly offers significant opportunity to reduce production costs and increase productivity of traditional businesses. Many are rapid growth, clean industries with minimal environmental impact.

In this particular region, the main new area of growth would be in advanced manufacturing systems. That is basically a wedding of the computer to the manufacturing process, and it was really hoped that the marriage would be beneficial to the small machine tool companies that exist in the Cincinnati area. If many of you read the Wall Street Journal recently, there was quite an article on the machine tool industry in the United States and, unfortunately, right now, the use by these companies of Japanese and German technology. Many of these U.S. companies have been small, family owned, and, unfortunately, over the years the Japanese and other countries were able to bypass the growth in the U.S.

A major part of the program to promote high tech growth in Cincinnati is the establishment of the Advanced Manufacturing Technology Institute as a cooperative effort. Also a New Business Venture Assistant Program was to be established. If you look back over any of the old line cities, this is really re-establishing the new venture spirit that flourished when any American city's industrial base was young. This same spirit needs to be rekindled.

In this program, industry also has an important role. Hopefully, it will establish close ties with universities and local government. In other words, what is intended is to tie together the existing educational base in the manufacturing technologies with a strong, but loosely knit, industrial manufacturing base through the machine tool industry. The thought was that there would be greater industrial credibility off campus. Also, it was hoped that the area in which the facility was placed would have sufficient attractiveness so that any new technology companies, or start-up companies, that result from the work would be physically located near this facility.

One of the major things that the Institute is intending to do is also provide a forum for faculty and graduate students in terms of joint appointment.

The Institute will have a campus setting and is currently looking for a director with a national reputation as a respected researcher. The research would be directed toward actual manufacturing needs and concerns as the primary R&D goal, but with capability to manufacture demonstration parts, with participation of visiting industry researchers. It would provide an advanced degree for the graduate student through industry sponsorship at the university. It would have a board of trustees with representation from industry, the academic community, and the government. In this case the State of Ohio through a bond issue, is providing seed funding and it is anticipated in order to minimize government control that within several years, it would be a break-even type of facility. The local Chamber of Commerce, then, is really the champion of the concept.

One of the anticipated benefits of this third-party intermediary private institute is a major upgrading of the University of Cincinnati through participation of faculty and by providing an industrial flavor to their advanced manufacturing technology program. Of major benefit to the city would be the tying together of one of the major industries and bringing those leaders together in a continuing forum.

Finally, it should provide a constant influx of new technologies for growth to compete, hopefully, with Japan and conceivably help maintain Cincinnati and the U.S. on the leading edge of manufacturing and technology through the integration of many of the new technologies. Thank you.

MR. CILLEY: Well, I think we are all very appreciative of the opportunity to hear the views of four people with a lot of different experiences and backgrounds. The questions raised look very interesting and, unhappily, we are not going to have sufficient time to deal with them in any depth or certainly in any completeness.

I would like to start by asking Harvard if he would respond to the first series of questions, that resulted from his presentation.

First, Mr. Hill, you said that the university should have a sixty percent share during the direct research and forty percent after commercialization. Since there are few if any cash flows during the direct research phase, what does the university have sixty percent of? Why, the difference in percentage?

I think that what is being asked is to have you sharpen a little bit more for us the distinction between what kinds of royalty screenings you are thinking of and how one distinguishes between the development or research part of the process and the point at which there are actually royalties from commercial sales of the resulting technology.

MR. HILL: Fine. I anticipated that I would get to that question. I think that the sixty-forty numbers are guidelines, and I think in a private corporate environment, such as a corporation, we would not do anything where we didn't have at least sixty percent control over the revenue stream of the profitability. I think as a sponsoring institution, you need to have that. After all, you are providing the historical precedent and protocol, the research, the people and environment, and contributing a great deal to it.

In order to make the transfer of technology, what I have seen that works the best is to take it from the applied research, or direct research, and do it in some form of a research involvement, such as a limited partnership. I think if you structure that partnership in such a way in a sponsoring university or research center, you can command sixty percent--and the question is sixty percent of what? I think if you are liberal in what goes into research and development (we all know what goes into research), but what goes into the development can be putting some of the projects or services out into the economic public sector for use and to bring back an income. At some point you can share in that profit stream at a sixty percent level before you release that service or that product line into the commercial atmosphere. In a privately-owned company or perhaps publicly-owned company, you would have a different sharing relationship.

It could be reversed to forty percent to the sponsoring research center and sixty percent to that corporation. Generally speaking, venture capitalists will require something on the order of about that magnitude--about forty percent return compounded annually pre-tax. A lot of numbers are driven off of that, so if you are going to make a transfer from a partnership or a private funding into the public funding sector it has got to be picked up where the person putting in the capital is going to see that or have a good expectation of that type of return.

I hope that is direct and to the point. I might just say one last thing on the sixty-forty relationship. A research and development partnership can be constructed in such a way that there is income coming so that the sponsoring university can get sixty percent of something.

MR. CILLEY: Thank you. A follow-up question from one of the people here this morning is directed on that point to Tom Tolbert and Wim Selders. Tom, you might be the first one to respond and Wim, perhaps second. The question is: For a large company, such as Monsanto, and Wim for a small company what is the sixty-forty sharing arrangement that Harvard is talking about?

Tom, would you care to comment on that?

MR. TOLBERT: We need to be very careful not to mix apples and oranges here. Frequently when we talk about research support, we are talking about research which is considered basic, but so far as its application is concerned, there is yet to be reduction to practice. This means that there is a great deal more work for somebody to do, and in essence the division is a function of how much

the participants bring to the project. Costs go up, as you know, expeditiously as you begin to cut metal, as the old timer says. But, as you begin to scale up and get into definition of product and commercialization of products, or if there is an acquisition of information at this very early stage, then you may well talk about royalties. Probably the fairest thing to do is rather than deciding royalty at the outset, is agree to negotiate in good faith at the time of commercialization when appropriate marketing information is available.

Different organizations do that differently. In my view, that is the fairest. If you actually acquire something on a venture basis, then it's a matter of how much confidence you had in the organization with which you were working. If you are really forming a partnership, then something greater than fifty percent is going to be necessary. If, on the other hand, it is simply an investment and nothing more than that, then it can be at a somewhat lower level.

I am not sure that I have answered the question, but I think we are talking really very different situations here, and I don't want to mislead anyone.

MR. CILLEY: Wim, what would your view of that be?

MR. SELDERS: With regard to the question of whether sixty or forty percent is fair, I have no way and no idea of knowing what is fair or not. All I know is that you have to find out first whether you need venture funding. If you could do it yourself, you don't need it. But if you do need money, you know you have to pay for it. In my opinion, you have to reduce it to practice like Tom is saying, here. I would advise you to take out your calculator and just find out whether that is fair basis or not, and whether one party is getting richer than the other party. But if everything seems fair and the return on the investment seems reasonable, then proceed.

MR. CILLEY: Dave, let's turn to your presentation for a moment. I have a couple of questions here on the general idea of how are opportunities for high technology growth and specific geographic location identified; what resources are required to identify these areas? How do you go about getting something like what you and your colleagues did in your case study? I think that is the essence of the question.

MR. KEATON: Well, one of the main features in revitalization that many cities have is, of course, that high technology is going to solve all of their problems. The first thing that we do is say let's attempt to first back off from there and have a general assessment of the economics of your region. Your city, your region, whatever that may be, and that certainly includes, first of all, interviews with all of the appropriate companies that are in the area, and the attributes, both of the physical area and, primarily, the educational system which exists. So, our main thrust in most of the economic revitalization studies is really one of attempting to build upon what that region already has, and believe it or not, many of the regions don't realize what they already have. So, it is first of all an assessment of that, combining that with the skill and capability of the university strengths and technologies and management skills of the city and government. From these results one can lay out a plan. Here is an industry, here is a technology. It became clear in Cincinnati, very quickly, that they had a hundred year old industry; one that was really on the verge of tremendous growth through robotics, computer assisted manufacturing, etc., but they were not really doing that much with those technologies.

So, here was the perfect bridge that was readily identified through the assessment technique of taking an old line industry and being able to marry the companies together, and at the same time, bringing in a tremendous influx of new technologies. It is the assessment, I think, that is important.

MR. CILLEY: Harvard, another question for you. Several brows wrinkled over the reference you made to a teaming agreement. Could you share with us your sense of what a teaming agreement is and how that differs from other forms of consortia arrangements, multi-lateral contracts and the like?

MR. HILL: A teaming agreement is something that we have used between Texas Medical Center and corporate sponsors that would involve a combination of research and technology and transferring that to the private sector for funding. I first ran into it in discussions at the home office of McDonnell Douglas. They used the teaming agreements with Johnson & Johnson, the Ortho division, which is sponsoring a project that has been up in the space shuttle the last three or four days.

The teaming agreement, basically, can be construed as a partnership agreement. It is probably less onerous on both parties. It does give progection and proprietary rights. It does cover termination clauses. It does cover expenditure sharing and it covers revenue sharing, and I think it gives the appropriate coverage to both parties. Stylistically, I think it puts both parties into an agreement, but is a little bit burdensome by a lot of legalese that can oftentimes restrict a working relationship.

We have what we think is one of the better law firms in Houston working on this particular arrangement between industry partners, corporations and research centers, namely the Texas Medical Center that involves a lot of different universities and medical centers, and we are using the terminology of a teaming agreement.

MR. CILLEY: Thank you. There is one for Wim. A person here this morning comments that a big problem with venture funding is that it is not usually terribly venturesome when all of the constraints on use are imposed, and the question is then where does the money come from for the fellow just past the idea stage? I think maybe a good way to look at that in the limited time we have, is to ask you as a representative of small companies that have design, manufacturing, and marketing capabilities, would you recommend people with this situation come to a small company? If not, how would you recommend they proceed?

MR. SELDERS: I will assume this person is part of the university. Well, the question is whether there is a need for just money or whether there is a need for working together. If a small company can be found that is working in the particular field of the idea, then it would certainly be very good to select such a company.

MR. CILLEY: I guess part of the implication of that is that small companies are interested in hearing about things like that directly.

MR. SELDERS: Yes, I would think that compared to a larger company, it might sponsor projects quicker, perhaps. A small company wants to make sure that the bottom line will show positive results after having put resources into it.

MR. CILLEY: Thank you. One last question here. This one for Tom Tolbert. It is one on which we have a number of question slips. The question is, are tax incentives an important consideration for a company the size of Monsanto and its decision making process to fund university research, and what legislative changes would you like to see in the future to provide greater incentives for industry-university cooperation?

MR. TOLBERT: It is a fair and just question. I think the same question came up in an earlier panel. There was division there, and I suspect there is division here. No one in this kind of relationship is funding research simply to gain a tax incentive. On the other hand, if you are on an ascending investment curve, so far as research is concerned so that you can take advantage of the law that may go out next year, as we presently have, then fine, you are most welcome to do it.

I think the answer is quite different for a number of small companies, and certainly for companies that are manufacturers of equipment and instrumentation, because there is some extra avenues of flexibility there, but for a company such as Monsanto, the tax incentive as it currently exists and as I understand it, is not a major factor at all in any of the decisions we have in funding research.

What changes in legislation would I like to see? Well, I believe one area is in anti-trust. Perhaps, I should check with counsel on this, but certainly one of the major questions that is open right now is in our limited partnerships is who, or what type of companies, some of whom compete with each other, can participate in a given partnership. That is yet to be challenged, and until it is, we really don't know that answer. I think it is an impediment to participation. It doesn't preclude them, but it certainly gives one pause, especially recognizing that the whims of legislative interpretation as we go from one administration to the next.

I guess I really have no comment about legislation in terms of encouraging research. I think research is going on and is rather healthy in this country. Moreover, we are discovering that we have a response to the Japanese peril or any of the other perils one might see in terms of the best R&D capability in the world, and a very, very strong industry. When we can put these two together, I think we have a very effective response there. I would hate to see anything disrupt that.

MR. CILLEY: Thank you, Tom.

I am told we are out of time. I hate to bring this to a close, because there are still a number of really interesting questions. I think you will agree with me that it has been a very interesting session Thank you.

Some of us are going to have to be leaving sometime during the afternoon or during the next day or so, but I know that all of my panelists will be here for lunch and certainly you can try to catch them as they streak for the door. Thank you again.

LUNCHEON ADDRESS

COOPERATIVE RESEARCH
WITH THE
SEMICONDUCTOR INDUSTRY

MR. MACCORDY: Ladies and gentlemen.

Today we are pleased to have a luncheon speaker who will discuss one of the most innovative and mutually productive arrangements which has been established in recent years between industry and research universities. We in universities have found ourselves with major problems in maintaining state-of-the art research and educational programs in computer science and electronics engineering. We have extreme difficulty maintaining the experienced faculty, the seed corn problem if you will, and the modern research facilities necessary to serve the needs of the country for educated manpower, as well as to make substantive contribution to the advancement of this technology.

In the last decade, many industries have found themselves falling behind in the struggle to hold domestic and international markets. Obviously, the semiconductor industry has made a strong commitment to retention of U.S. leadership in their field of technology.

This brings me to our luncheon speaker, Larry W. Sumney. He has had a distinguished career which commenced in the Naval Research Laboratory involving research and engineering in electronics. In 1970, he served in the Naval Electronics System Command as Manager of the Tri-Service Charged-Coupled Device Program. Subsequently, he was head of the Solid State and Special Device Technology branch and Research Director for this command.

In 1978, he joined the office of the Undersecretary of Defense for Research and Engineering in the VHSIC program; the program to develop very high speed integrated circuits.

Mr. Sumney became Director of the VHSIC program, as well as Chairman of the VHSIC Committee and Executive Secretary of the VHSIC Executive Committee. In 1982, he assumed his present position as Executive Director of the Semiconductor Research Corporation, an orgainzation formed by the semiconductor industry. To discuss how SRC has organized its innovative program, I take pleasure introducing Mr. Larry W. Sumney.

MR. SUMNEY: The Semiconductor Research Corporation (SRC) is a new organization that is implementing an innovative form of industry-university cooperation in research related to semiconductor devices. The SRC's goals are to plan, promote, coordinate, sponsor and conduct research that will result in (1) new knowledge of semiconductor materials and phenomena, and of related scientific and engineering subjects that are required for the useful application of semiconductors; (2) the development of new and more efficient design and manufacturing technologies for semiconductor devices; and (3) an increase in the number of

scientists and engineers that are proficient in research, development, and manufacture of semiconductor devices. An equally important SRC task is to efficiently communicate the results of its research to its industrial members.

The SRC is a natural derivative of the development of semiconductor technology in the U.S. The generic technology on which this industry is based was spawned by the Bell Telephone Laboratories in the fifteen years following the invention of the transistor with a major infusion of funding from the defense establishment for research in both industrial and university laboratories. The growth of the semiconductor device industry was so rapid that by the mid-1960's developments within the industry were outpacing the ancillary research community. Both Bell and the Department of Defense (DOD) refocused their efforts to the application of the fruits of their earlier research rather than the continued advancement of the generic technology. Support of academic research shifted in emphasis to longer range, more speculative areas such as compound semiconductors. Research directed to both the near-term and long-range needs of the mainstream semiconductor industry was largely confined to the laboratories of the companies producing the devices. Both merchant producers and the growing number of captive semiconductor producers were involved. These circumstances had negative impacts. First, the competitive companies were reluctant to share research results that might provide a competitive advantage. This slowed, but did not stop the diffusion of new results. Second, the research efforts became highly redundant. Each company found it necessary to apply its efforts to very similar topics in order to avoid being left behind in a critical, rapidly developing technology. Gradually, research became focused on solution of near-term problems, and the generic technology for the longer range future was neglected. Third, and most important, the structure of the industry and the economy resulted in an erosion of the resources available for research, and it was necessary for each company to apply these resources to current product development in order to remain competitive.

It is important to note that research in compound semiconductors is an important element of the generic technology for future semiconductor products. However, it represents just one of the areas that need to be addressed. It is just as possible that new generations of capabilities may be based on the evolution of silicon technology into radically new device structures as it is that new but less developed material systems, such as the III-V semiconductors, will provide these capabilities. Each candidate technology must be addressed in a comprehensive generic technology at a level commensurate with its perceived role.

In late 1981, executives of major U.S. companies that produce and/or use semiconductor products recognized that this erosion of the generic technology base coupled with government financed efforts in other countries constituted an important competitive threat to their industry. Recognizing that a government-based response to this threat was unlikely, they decided to undertake a cooperative industry-initiated response. After considerable discussion, a concept emerged that has become the SRC. This concept is that SRC will:

- Be sponsored by member companies through fees based on semiconductor sales or usage, or semiconductor-related sales.
- Provide knowledgeable and professional planning of an industry-wide research program.

- Contract for research to be coordinated by an industry/SRC technical advisory board.
- Play an active role in monitoring research progress and transferring results back to industry.
- Establish both:
  - University centers of excellence with long-term, major, thrust areas.
  - Additional research activities based on shorter term, more precisely defined objectives.
- Result in:
  - Establishment of a major, focused, generic research program supportive of the needs of the semiconductor industry.
  - More relevant graduate education and a larger supply of graduate students.
  - Improved communication within the U.S. semiconductor community.

Subsidiary research objectives that are consistent with this concept include objectives such as to:

- Provide a clearer view of directions, limits, opportunities, and problems in generic technologies.
- Decrease fragmentation and redundancy in U.S. semiconductor research.
- Establish above-threshold research efforts for critical areas that are beyond the resources of many cooperating companies.
- Enhance the image of the industry in order to attract needed talent.
- Increase industry-university ties.
- Provide a scientific and technical information base for industry development efforts.
- Attract highly qualified students to graduate programs in semiconductor research.
- Help universities to attract and retain competent faculty in semiconductor related areas.

As part of this set of objectives, it was agreed that the SRC program should encompass universities that are not presently leaders in semiconductor research in order to broaden the institutional base, while increasing the level of effort in universities already active in this technology.

By early 1982 the SRC concept was sufficiently advanced to where, under the aegis of the Semiconductor Industries Association, the SRC was incorporated and by-laws were written. In May 1982, I was hired as Executive Director of the SRC. In September 1982, offices of the SRC were established in the Research Triangle Park of North Carolina, initial staff was hired, and efforts to establish the research program were initiated. By November, 1982, contractural procedures were initiated for eight universities which were selected for award of the first research contracts and 166 proposals were received from 63 universities. By June, 1983, over thirty universities were participating in the SRC research program. At this time, the program has expanded to about forty universities and represents nearly $12 million.

The SRC exists as a cooperative effort of companies that produce or use semiconductor devices or are major suppliers to the semiconductor industry. Present membership includes:

Advanced Micro Devices, Inc.
Burroughs Corp.
Control Data Corp.
Digital Equipment Corp.
E. I. du Pont de Nemours & Co.
Eaton Corp.
E-Systems, Inc.
GCA Corp.
General Electric Co.
General Instrument Corp.
General Telephone and Electronics
Goodyear Aerospace Corp.
Harris Corp.
Hewlett-Packard Co.
Honeywell, Inc.
IBM Corp.
Intel Corp.
LSI Logic Corp.
Monolithic Memories, Inc.
Monsanto Co.
Motorola, Inc.
National Semiconductor Corp.
Perkin-Elmer Corp.
RCA Corp.
Rockwell International
SEMI Silicon Systems, Inc.
Sperry Corp.
Texas Instruments, Inc.
Union Carbide Corp.
Varian Associates, Inc.
Westinghouse Electric Corp.
Xerox Corp.

By the end of 1984, nearly three dozen companies are expected to be members of the SRC and supporting its research activities on the basis of an established fee schedule.

The SRC is operated by a Board of Directors (BOD) consisting of the following individuals, for the period of May 1, 1984 to April 30, 1985, representing the member companies:

Mr. Eugene J. Flath (Chairman)
Intel Corp.

Dr. Paul R. Low
IBM Corp.

Mr. Michael J. Callahan
Monolithic Memories

Mr. Jon E. Cornell
Harris Corp.

Mr. Albert C. Kibbler
Honeywell, Inc.

Mr. J. W. Lacey
Control Data Corp.

Mr. Carmelo J. Santoro
Silicon Systems, Inc.

Mr. George M. Scalise
Advanced Micro Devices, Inc.

Mr. Gregory Harrison
National Semiconductor Corp.

Mr. Bob J. Jenkins
Motorola, Inc.

Dr. Jeffrey C. Kalb
Digital Equipment Corp.

Dr. Fred Schwettmann
Hewlett-Packard Co.

Mr. Tim B. Smith
Texas Instruments, Inc.

Mr. Larry W. Sumney
Semiconductor Research Corp.

The BOD establishes major policy for the SRC, approves major contract awards, approves the appointment of Technical Advisory Baord (TAB) members and key members of the professional staff, and oversees the development and operations of the organization. It is elected annually by the Semiconductor Industry Association (SIA) Board.

The TAB of the SRC has the following membership:

Dr. R. M. Burger (Co-Chairman)
Semiconductor Research Corp.

Mr. J. Philip Downing (Co-Chair.)
Advanced Micro Devices, Inc.

Dr. Grant A. Beske
E. I. Du Pont de Nemours & Co.

Dr. Wilmer R. Bottoms
Varian Associates

Dr. Charles T. Brodnax
E-Systems, Inc.

Mr. Don Butler
General Instrument Corp.

Dr. Bernie Chern
National Science Foundation

Dr. Billy L. Crowder
IBM Corp.

Dr. James M. Daughton
Honeywell, Inc.

Mr. Melvin Davis
Goodyear Aerospace

Dr. Conrad Dell'Oca
LSI Logic Corp.

Mr. Robert F. Elfant
Burroughs Corp.

Mr. R. M. Goldstein
AT&T Bell Laboratories

Mr. Dave Kirkwood
Sperry Corp.

Dr. Harold W. Korb
Monsanto Co.

Dr. W. W. Lindeman
Control Data Corp.

Mr. Robert D. Lohman
RCA Laboratories

Dr. Michael Michael
Westinghouse Electric Corp.

Dr. Frank Micheletti
Rockwell International

Dr. Arnold Miller
Xerox Corp.

Dr. Gerry Parker
Intel Corp.

Dr. Kenneth A. Pickar
General Electric Co.

Dr. G. R. Mohan Rao
Texas Instruments, Inc.

Mr. Raymond P. Roberge
Union-Carbide Corp.

Mr. Michael Rynne
Monolithic Memories, Inc.

Dr. Thomas Sanders
Harris Corp.

Dr. Dragan Ilic Hewlett-Packard Company	Mr. L. David Sikes Motorola, Inc.
Dr. S. V. Jaskolski Eaton Corporation	Dr. Court Skinner National Semiconductor Corp.
Mr. Gary Kelson Silicon Systems, Incorporated	Dr. Kenneth Slater Digital Equipment Corp.

The TAB has an active role in the evolution of the research program of the SRC participating in the evolution of the research strategy and the evaluation of proposals. It will provide an important conduit for the flow of information from industry to SRC research contracts, and for the flow of research results from the SRC to industry.

The full-time SRC staff consists of both regular, permanent employees and industry personnel assigned to work with the SRC for defined tours of one year or more.

Larry W. Sumney, President
R. D. Alberts, Staff Vice President, Policy & Planning
R. M. Burger, Staff Vice President, Research
R. K. Cavin III, Director, Design Sciences
W. C. Holton, Director, Microstructure Sciences
R. E. Darby, Jr., Director Administrtion
J. J. Cox, Program Manager, Packaging
J. R. Key, Program Manager, Technology Transfer
M. D. Connelly, Manager, Information Systems
S. E. Connor, Administrative Support Assistant
R. D. LaScala, Contract Administrator
S. R. Fallin, Secretary/Word Processor Operator
T. S. Johnson, Secretary/Word Processor Operator
K. A. Olive, Administrative Support Assistant
M. U. Regan, Publications Coordinator
K. A. Spruill, Travel & Conference Coordinator
C. L. Taylor, Financial Assistant
S. D. Thomas, Administrative Services Coordinator
W. M. Wagoner, Finance Administrator

This staff, under the direction of the BOD and with the advice of the TAB, formulates and implements the research program of the SRC. It is intended that the permanent staff remain small so that the active participation of the BOD, TAB, and industry assignees will continue to be necessary in order to carry out, manage, and direct the SRC program. In addition, it is planned that each contractor will have an industry individual identified as an industry resource contact to provide assistance and information when required.

Before the SRC research program was initiated, a strategy for the program was adopted that identifies the major areas of interest. The major areas identified in this strategy are:

° Microstructure Sciences
  - Materials, Phenomena, and Device Physics
  - Microsciences
  - Device Fabrication Technologies

° Design Sciences
  - Design Automation
  - System - Component Interactions

° Manufacturing Sciences
  - Manufacturing System
  - Automation, Robotics
  - Process Modeling and Simulation
  - Packaging
  - Reliability, Quality Assurance, and Testing

A three-tier layer of research activities is envisioned consisting of individual project awards, centers of excellence, and lead centers. The first level is intended to comprise those research activities centered around one or several faculty members and their students awarded in a competitive process based on solicitation of proposals for innovative research. The implementation of the first of these solicitations will be described below. At the second level, centers of excellence are being established both through negotiation and competition. These centers will comprise team efforts with themes that can correspond to major areas in the strategy or other mutually acceptable topics that are deemed to be of significant importance. An effort is being made to supplement center themes with research vehicles that provide additional focus to the efforts. The third tier of planned research activity is identified as a lead center and conceptually provides a framework for amalgamating related efforts and facilities of multiple institutions into a structure of coordinated research. The implementation of lead centers will evolve from the present project-center activities at some time in the future.

In addition to the three-tier structure of research described above, an additional program component referred to as a "new thrust" is provided. This is a mechanism for implementation of focused research efforts that respond to needs, opportunities, or technological threats beyond the outlined research strategy. Such efforts will be initiated either through competitive solicitations or from unsolicited proposals. Examples might include areas such as compound semiconductors, high power IC's, novel architectures, electro-optical IC's, or precision processing.

The initial implementation of the SRC research program was based on a broad solicitation for research proposals that was distributed in September and October of 1982 and on several unsolicited proposals. The competitive solicitation resulted in 166 proposals that were evaluated and ranked in the three major categories of the research strategy. This process resulted in a decision to make awards of approximately forty contracts to twenty-six universities. In addition, thirty-seven proposals from two universities, RPI and MIT, and one university group, the Microelectronics Center of North Carolina, were removed from the competitive evaluation and are serving as a basis for the establishment of three well-focussed research programs. In parallel with this broad solicitation, centers-of-excellence have been established at Cornell University in the area of microscience and technology and at the University of California/Berkeley and Carnegie-Mellon University in computer-aided design.

The SRC, with a 1984 budget of approximately $13.5 million and a budget of over $16M for 1985, is rapidly establishing a structured research program that responds to the generic technology needs of the semiconductor industry. Its initial research efforts have focused on addressing nearer-term return-on-investment to its members, the SRC will address the full range of science and technology that will significantly contribute to the advancement of semiconductor technology both in this decade and on to the turn of the century. With the support of a growing number of industrial participants, this research will become a major factor in establishing the technology for the information age and will assure the U.S. industry a position of continued leadership in the semiconductor field as well as in the myriad application areas that depend on advanced semiconductor devices.

SESSION III

INDUSTRIAL AFFILIATE PROGRAMS
WINDOWS ON NEW DEVELOPMENTS IN TECHNOLOGY

MR. DUMMER: In recent years, a number of questions have been raised with respect to industrial affiliate and associate programs at universities. For example, are some of these programs too broad or too general, and should they be more focused to assure greater attention and commitment from faculty? How should they be financed so that small and medium-sized companies will have perhaps more opportunity to participate? Can affiliate programs be more effectively utilized to assist state and regional economic development effort by providing a focal point for the local economy?

This brings us to Session No. 3, "Industrial Affiliate Programs--Windows on New Developments in Technology."

It is my pleasure to introduce your moderator, Phyllis Lewis, Assistant Director, Research Services, University of North Carolina at Chapel Hill.

MS. LEWIS: The potential benefits of Industrial Affiliate Programs are well acknowledged by now and certainly this session will, to a great extent, dwell on these and the rationale for the extension of the arrangement, as well as the most effective ways of setting up good programs. But by now, many such affiliate programs have been in existence for a number of years, and we are able at this point to step back and scrutinize them critically to see how they can be made more viable.

Our speakers will discuss some of the concerns recognized by both sectors, such as maintaining proper faculty attitudes and meaningful institutional commitments, as well as ensuring that the expectations of sponsoring industries are indeed realistic. More importantly, perhaps, our speakers will define some of the challenges posed by this mode of research sponsorship that call for real creativity and cooperation among all the parties.

To my left, Dr. David C. Johnson, Dr. John Ambrose, and to my right, Dr. Goldstein, Dr. Jones. I will introduce them individually before they speak.

First, it is my pleasure to introduce David C. Johnson, who is Vice President for Development and Administration of the Darden Graduate Business School, a private foundation which supports the Colgate Darden Graduate Business School at the University of Virginia.

Dr. Johnson is in charge of all continuing fund raising activity directed to alumni, friends and corporations, as well as the management of the foundation's assets and personnel. He also holds a faculty appointment with the Darden Business School and teaches business communication.

Prior to his appointment at the Colgate Darden Graduate School, Dr. Johnson had been at Cornell University since 1969 where he served as Director of Corporate Relations. In this position, Dr. Johnson was the primary contact for industrial interaction with Cornell's several schools, colleges, and related academic programs. While at Cornell University, he was heavily involved in the organization of five affiliate programs, which collectively involved about eighty member companies, focusing on geophysics, submicron electronics, environmental toxicology, computer graphics, and manufacturing engineering. He was heavily involved also in organization of Cornell's Biotechnology Institute program, which will draw $7.5 million annually in research support from various companies.

Dr. Johnson, in his presentation today, will present a case for corporate support of university research and explain his views on what makes an effective corporate relationship. He will speak primarily from the point of view of the larger research university.

MR. JOHNSON: Thank you, Phyllis. I am delighted to hear what I am finally supposed to speak about. I do have some observations and experiences I want to share with you. I got into this business in sort of a backward way, quite frankly, having ten years experience at Cornell on the staff of the engineering college.

I have had a lot of experience in the last week with the questions of industrial affiliates programs. I spent two days last week at AT&T Information Systems, responsible for their entree, if you will, into the computer business. At one point during my two-day visit, one of the staff brought out a large folder which contained, I would guess, not less than fifty invitations to joint corporate affiliate programs. In a word they said "what should we do", and I said "heck if I know." They are clearly groping. There were invitations from institutes that were very well known and surely would be of benefit to the AT&T Corporation, and there were invitations from obscure institutions which probably had little to offer AT&T and their specific mission which is moving fast into a field in which they have limited expertise.

I think that in a word sort of summarizes where the industrial affiliate program stands. There is very little information. I am sure many of you who sit at the industrial desk, if you will, are beleaguered with invitations to join. If you add them all up, it is a substantial contribution you are talking about. Why has that happened? From my perspective, there are two reasons. First of all, the university regards it as a relatively easy source of unrestricted funds. I hate to say that, but, in fact, it is true and I think it is a serious misconception. The second reason is that it is a relatively low cost risk, and I think this is an accurate perception.

Clearly, we are in a state of some mismatch. Those of you who, again, sit in the corporate office, have to be very attentive to which programs would offer you the kind of benefit that your organization needs in both the short and the long run. What Phyllis should have also mentioned, is while I did get very much involved in the development and articulation of five explicit programs at Cornell, I was also instrumental in defeating at least ten. I often take pride in the fact that we defeated more than we promoted. We actually did get into the area of promoting. We would do so if, as a collective decision with the research officers at the University, we felt that the program was truly viable enough to draw corporate interest and the faculty were willing to sustain that interest.

First of all, the university administration, namely the president, trustees and something called the development staff, are usually relatively insensitive to the individual needs of research programs, or individual faculty. Their fund raising priorities are clearly determined by parties other than individual faculty and usually oriented on particular major items such as athletic facilities and the list goes on and on and on.

The development staff are what I often call smiling faces. They are usually distinctively nonacademic in orientation, have very little academic experience and usually report to that big smiling face, the vice-president of public affairs. Once in a while, they run into an academic officer at a cocktail party.

Second, the office of contract research or sponsored programs historically, and I think this is changing as this conference exemplifies, has a heavy orientation toward the traditional sources of research support, such as the NIH, the NSF, the DOD, and others. They have little or no experience with the individual donor, with corporations or private foundations. Quite frankly, little experience leads to lack of access. To whom does the faculty member talk?

Third, deans or department heads are usually quite sensitive to individual faculty needs, but regard it as primarily an entrepreneurial activity. They may lack an explicit understanding of the program's potential value, particularly, if it is out of their intellectual mainstream. A dean who is an expert in microscience, may have a very difficult time coming to grips with some other area totally out of his experience. Of course, we all know that the dean is simply bombarded with the demands of his/her own office, the administration,and they have just limited time available.

The final constituency that we all deal with in a university is, of course, the alumni. They are usually not informed about faculty research at all. They usually have little or no appreciation of the value of academic research and they only take note of a faculty issue when it results in something that is highly profitable and visible.

Obviously, these realities discouraged many faculty members. Some came back and said in spite of it, let's go. We are willing to commit the time and the effort that is necessary. Based upon my experience, there were really five attributes that characterized a successful program. The first was that the program did not have any liabilities upon entering into an associate's program. The research program was often, if not usually, well funded, and the existence of an associate's program would not make or break it. I think the Submicron Facility is an excellent example of what Cornell did in this field. Before the SRC was even organized, the NSF had pumped something like eight million dollars into the submicron program at Cornell, and something like two million dollars additional was straight gifts and grants from corporations. It was then that SRC began to get into the act. You have to go with a winner. It is that simple.

Two, successful programs involve a quorum of faculty, often representing interdisciplinary interests, cutting across departmental lines and often school lines. One-man programs, plus an errant garbage truck on a Wednesday morning, leads to the quick demise of a program. We simply refused to invest our time and effort into any kind of an associates program which was going to be what we call "personality driven." We insisted upon the support of junior and senior faculty.

Three, a productive graduate field had to exist. To our satisfaction, the program had to demonstrate the production of a graduate degree, hopefully, at the Ph.D. level, either standing alone or in close association with another graduate field.

Four, there had to be a demonstrated willingness on the part of the faculty to service client companies. We asked them to acknowledge and accept up front the inevitable quid pro quo which characterizes the point of any program. Some faculty were very willing to make that kind of personal investment, others were not.

Finally, the entire association or affiliation must be based on the value of the exchange of ideas, and not the exchange of money. That had to be the driving force behind the desire to involve companies in any kind of research program.

I am sure you are all familiar with, perhaps, the two most prominent examples of affiliate programs. Certainly, one is MIT and its ILP, a very well-established program, which, offers institutionalized access to something in the order of 350 client companies. MIT is already groping with the issue of separate industrial affiliates programs, but, nevertheless, the ILP provides a very convenient conduit, if you will, a very convenient window on the technology at that institution. At the other extreme, Stanford University at last count had something on the order of twenty-two affiliate programs, ranging from earth science to space study. Companies can pick and choose those areas that they want to associate with, and it is not uncommon for some companies to be affiliate members in five or six programs of particular interest to them.

What are the corporate benefits? I think we all know them, but let me say what I feel are the three most important. First of all, is a systematic and regular exposure to leading faculty members and their research.

Number two, exposure to the graduate students who are potential employees is, in my opinion, the most effective means to accomplish what we call "technology transfer." It always amazed me the number of companies that supported contract research on the campus. However, when they come to town they would fall all over the faculty member, but ignore the graduate students who are, of course, doing all the work. The fastest way to effect technology transfer is to hire the brains that did the work.

Three, is the opportunity to shape a research program. To suggest research initiatives that might not otherwise come to the attention of faculty, and I think oftentimes the most successful programs are those that are characterized by that kind of interplay.

How do you judge success? Quite frankly, industry wants more, and they look at their association, their affiliation, and whatever costs may be involved as a very simple means to an end, and that end is to gain familiarity, to broaden your interaction; whether through a single contract or several contracts; whether through direct support of graduate education, or through equipment grants, etc. But the successful affiliation, in my opinion, over a three to five year period will result in a much broader, more penetrating association with that department than would have developed with a company simply cutting one check a year for fifteen or twenty thousand dollars.

Thank you very much.

MS. LEWIS: Our next speaker will be Dr. J. I. Goldstein. Dr. Goldstein took his degrees in metallurgy from M.I.T. He has worked as an aerospace technologist at Goddard Space Flight Center and has been at Lehigh University since 1968, most recently being appointed to Vice President of Research. One of his primary responsibilities is to coordinate the liaison programs with industry.

MR. GOLDSTEIN: Thank you very much. First, I would like to talk a little bit about our industrial affiliate program, which will be from the perspective of a case study of a relatively small research university. Then I will talk about our Ben Franklin program in Pennsylvania, which is trying to use the universities to help create jobs and assist with economic development in Pennsylvania.

Now, to put you in the picture, Lehigh is a medium-sized university with its major research activity in engineering and science. We had $9.3 million worth of supported research last year. Of this amount, fully twenty percent is from industry, something like five times the national average. In 1962, Lehigh decided to move from a group of fine undergraduate engineering, liberal arts, and business schools to become a research university. We decided to use our national linkage with industry to help develop such a program.

Besides normal research contracts, we started targeted liaison programs with industry. We recognize that we are not a fully comprehensive research university; that is, we do not have a competence in all areas of science and technology, and yet, in most areas of research in which we have become known nationally, we have started liaison programs. These programs include the areas of materials research, energy, microelectronics, biotechnology, and in the new field of computer-aided design and computer-aided manufacturing.

We charge ten to twenty thousand dollars per year per company to belong to these programs. And in some of these programs, we provide services in the form of direct consulting, participating in short courses, lectures given at the industry, and invitations to come to campus to see what we are doing. That last item is the industry's window on our technology. We use the excess income from this program in a local way. In other words, the sponsoring discipline gets the income, and the faculty of that group decide how to use it. Last year we had income exceeding $1.2 million. Recognize that amount, when compared to 9.3 million of sponsored reasearch, is a significant program at our university.

Since 1970, industrial consortia have also been developed. For example, thirty-eight companies now belong to our emulsion power consortium. These monies support generic research in this area, and for that the companies come to campus two times a year to hear research results, to work and see the graduate students, and also to discuss the research agenda for the next year. In this consortia, interestingly enough, we have six foreign companies participating. Today we have two additional industrial consortia in the development state. One is the Center for Innovation Management Studies. This is an interesting coupling of our business school with some of our research faculty. Its focus is to understand how to translate ideas that develop in research laboratories into something that can be used efficiently by industry. Also, we are developing a Center for Process Modeling and Control. We already have some members in both of these programs, and we are now looking for further participation of industry and of government, particularly through the NSF university/industry program. Again, as in all of these programs, the research agenda is developed cooperatively with industry.

So at Lehigh we have two types of industrial liaison programs. One, an affiliate program, and the other an industrial consortia program. We find that there are advantages of both programs to the university. The main advantage, I think, is faculty exposure to industrial programs. The faculty that participate in these industrial liaison programs enjoy them. They get to work with industry and this kind of information eventually arrives in the classroom. The income that we get from these programs is targeted directly back to the faculty. Thus, there is a driving force for the faculty to participate. This translates into new equipment and support for students, travel and the like.

One of the major advantages of these programs are the derivative research grants that come from industry. There is also the possibility of patent development and in several of these programs that has already occurred. We also give the industry timely attention to problems. The industry calls up the industrial affiliate program and they get somebody to help them; they get an answer in a short time period. Companies also establish a formal relationship with the university, and through that they can then have an interface with other areas on campus. I see this as a win-win situation. Both sides come out in very good shape.

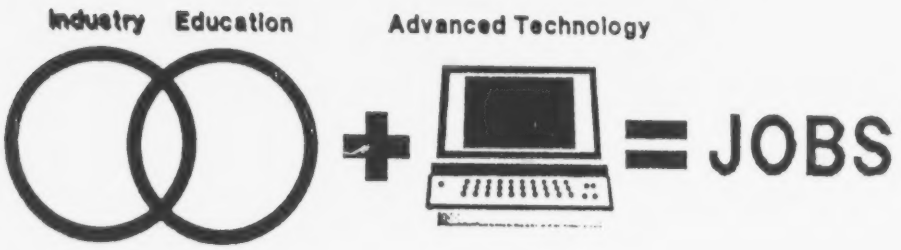
In 1982, just a couple of years ago, Lehigh University became involved in the State of Pennsylvania's Ben Franklin Program. The State recognized that there would be an advantage if it could interface with industry by working together with the university. The intent of the State was to accomplish two things: to preserve jobs in the State of Pennsylvania and to establish new or expand existing industry in the State.

Let me talk a little bit about the Ben Franklin Program, because I think it can serve as a model for some other people who may be thinking about programs along these lines. Figure 1 is a schematic of what the Ben Franklin Program provides. It is an industry-university partnership to advance technology and from the state's viewpoint it is a program that creates jobs or saves jobs in the State. As you see in the figure, there are three purposes for the Ben Franklin partnership in terms of industrial emphases: 1) to help traditional Pennsylvania industries, many of which are classified as the traditional smokestack industries; 2) to attract nationally large and small technology industry leaders; 3) to assist start-up firms, which we refer to as incubator companies.

What we have been working with is an advanced technology center concept to develop a partnership between universities and other educational institutions in the northeast part of Pennsylvania, with Lehigh as the lead university, and industry. Altogether, there are thirty-eight educational institutions which have formal agreements with Lehigh's Ben Franklin partnership. A hundred and forty-two companies are working with us in one way or another in this partnership. We have four small business development centers funded by the government and we have altogether twenty-nine government and economic development organizations involved. The idea is to couple industry with research and development in our institution and other institutions in our area to foster economic development. The State provides money for this program.

There are four advanced technology centers in the state: Lehigh University in the northeast part, the University of Pittsburgh in the western part of the state, Penn State in the middle of the state, and, the University Civic Science Center in the Philadelphia area. There are also people here at the conference from Carnegie Mellon and from Drexel.

BEN FRANKLIN PARTNERSHIP



- Preserving Existing Jobs
- Creating New Job Opportunities

Industrial Emphasis

- Help Traditional Pennsylvania Industries
- Attract National Large & Small Technology Leaders
- Assist Start-Up Firms Sometimes

Figure 1.

NET-ATC

Funding

	Year 1 March '83 - Aug. '83	Year 2 Sept. '83 - Aug. '84
Ben Franklin Partnership Fund: (Pa Dept. of Commerce)	$ 250,000	$ 2,900,000
Private Sector	923,430	6,800,000
Other	212,000	1,880,000
Totals	$1,385,430	$11,580,000

Figure 2.

Figure 2 illustrates the kind of funding that is being used by the State. The program is in the second year and the levels of funding are shown. The level of the partnership fund, or the money put in by the State, was to provide a quarter of a million dollars to Lehigh in the first six months. The total was one million dollars in the State for that first six-month period. During the second year, ten million dollars' worth of funding was available overall, with 2.9 million dollars of that coming to Lehigh. As one can observe we have leveraged the State money to provide almost two or three times more from the private sector. We also have other participants which have put their money into this program. The Lehigh Center is obtaining three million dollars from the State and over eleven and a half million dollars for this program from all sources. Just within the last year the State has almost doubled its contribution for year three, starting in September 1. For example, the Lehigh Center will be receiving 5.1 million dollars for its program in the upcoming year. So this is a large expanding program for the state.

There are three funding sources which are primary to this program. One is the industry-university R&D program. It is an R&D program which is intended to be short range; an advanced development kind of program that leads to new products and processes. It is not a program that is attempting to provide government or industrial funding for long range basic research, but is intended to take advantage of the cooperative spirit that is available through the university and industrial affiliate programs.

Another fund source is an educational and technological training program and the third source is an entrepreneurial assistance program intended to develop new companies, stimulate seed and venture capital formation for the use of local companies.

The Ben Franklin program is designed to support these areas in a number of ways. First of all, it combines the state money with money contributed by industry on a matching basis. Funds are available to start-up firms to support specific projects with the majority of the money going into such support. Funds for these projects provide support for equipment and faculty time, for providing specific services and other assistance. These are the four R&D technology thrusts at Lehigh. These are computer assisted design and manufacturing, microelectronics, materials and biotechnology. We have activities in all of these and we have elected to capitalize on these areas as our lead technologies. About two-thirds of the funding that we use now is in the CAD/CAM area and we are working with many companies applying that technology to their particular needs.

Also, we are interested in starting a number of small business incubator centers. We have two facilities at Lehigh which are filled with incubator companies. These are small companies, typically a couple of individuals working to develop certain areas or ideas. We are providing offices, lab space, and central conference rooms. We provide the assistance of accountants and lawyers who have volunteered their time and effort as part of the incubator center. Also, we are providing links to venture capital companies and are providing access to specialized equipment. We charge a very low rate and expect the incubator companies to stay in our incubator facility for just a couple of years. If they are successful, they should be able to go out into the community on their own; if they are not, then of course you know what happens there.

Figure 3 is a listing of some of our incubator companies, which are presently in our two facilities. We have a software consulting service, a robotics company, and a computer company, which manufactures hardware. We also have a computer service company that supplies computer access to a large local network in the Lehigh Valley, and we have a materials company which is interested in thin films. All of these companies started within the last year and a half, and we would expect that eventually we will come to sort of a steady state level of about twenty companies in our particular facility. In fact, we are looking for a third place to put companies right now.

Figure 3.

It is clear that Lehigh wouldn't get involved in this activity if we didn't think there were some benefits to us. We have seen benefits to us and to a number of our cooperative educational institutions such as acquisition of state-of-the-art equipment facilities. We have obtained support for a large number of our faculty and students, and we have access to private sector technology and expertise, access to many companies that was a result of developing the partnership agreement. We also have provided direct contact for many of our students with many of the cooperating industries.

I think that the industrial affiliates program that we started some twenty years ago with the hopes of involving industry with our university has worked very well. We felt very comfortable with this Ben Franklin program as it started out, and we feel that this is going to benefit the state and the university as well as a number of other institutions.

MS. LEWIS: Our next speaker is Dr. John Ambrose, who is Director of External Technical Affairs with GTS Laboratories in Massachusetts. In this position which he has held since 1971, he is responsible for the planning, administration and management of GTE labs academic involvement program. Dr. Ambrose's responsibilities have included developing an international program of academic liaison and technological monitoring and establishing and operating a series of academic and industrial research and development institutes. Prior to joining GTE, Dr. Ambrose was with Litton Industries as Director and Chief Scientist for the Litton Scientific Support Laboratory at Fort Ord and Hunter-Liggett Military Reservation, California.

MR. AMBROSE: Thank you. At this point in the program, the speakers begin to see that many of the facts they have to offer, and many of the points which they had hoped to make, have been foreshadowed and even pre-empted by the previous speakers. I thought I still had something left to offer, then David shot me out of the water. However, I do think I have one item that I believe is still fresh information. I am going to get rid of it quickly before somebody else gets to it.

I recently, quite by accident, attended an educational conference, and I found it was attended entirely by the presidents and deans of colleges and universities in addition to myself. They either didn't know I was there, or they forgot I was there, and it was a very, very revealing experience, indeed. One of the two most revealing experiences in my life. I carried away one thing which I shall always remember; I now know what a dean does. It is the function of the president to speak for the institution. It is the function of the faculty to think for the institution. It is said that it now becomes the function of the dean to keep the president from thinking and the faculty from speaking.

Allow me to add that although I am going to be covering some of the same points you heard, perhaps I can present them in a new pattern, so that all of you, especially those from the universities, can carry them away and use them to your betterment.

In these times in which the federal support of academic research is at best level, and at worst decreasing, colleges and universities are turning again to industry for much support. I believe that industry for its part is increasingly responsive, but there is a pressing need for mutual introduction and acquaintance.

In response to this need, the three thousand colleges and universities of the United States have proliferated organizations designed to introduce industry to the various academic institutions. It has been found that funding can be obtained, often in large amounts, through the annual membership fees charged to participating industries. These organizations bear various names in different institutions, such as industrial liaison programs, affiliate programs, associate programs, forums, collegiums, and even others. While some institutions have maintained such functions for a decade or more, the great majority have been recently established, re-established, or rejuvinated.

The programs appear at various institutional levels: the university, the college or school, the department, or in various intradisciplinary centers or institutes. Many may co-exist at the same time in the same institution, either by plan or by accident; either in competition or in a complementary manner.

Similarly , these various organizations target industry at different levels, the corporate, the subsidiary or division, the department, or the facility location. Again, this may occur by planning or by accident. Every level of the corporation is offered a great variety of such opportunities from many institutions. The institutions in which careful planning and coordination are used to identify target industries enjoy a considerable advantage in recruiting membership. If these factors are left to happenstance, counter productive situations readily develop.

Let me now consider the attractive elements of one of the oldest and most satisfactory such affiliates programs to which GTE has belonged for a number of years. This program provides for full-time points of contact, called liaison officers, to implement the program. As it is a large program with many corporate members, there are in fact several such officers, each serving a small group of clients. They have no other duties. As obvious as it may seem, they should be recent graduates of the institution, with a student's intimate knowledge of the faculty and facilities. We have seen the contrary attempted with predictably poor results. There is an explicit hierarchy of such outreach programs, a liaison office at the institution level, affiliates programs at the school or division level, and forums or collegiums at the departmental level. They, in turn, target corresponding levels of the corporation, i.e., the Liaison Office targets the Corporate level, the affiliate groups target subsidiaries and divisions, and the forums (and collegiums) target departments and individuals. Each level offers the next lower level bargain membership rates, thus integrating the whole.

Academic institutions generally prefer unrestricted funds. In the corporation, such funds are budgeted as philanthropic funds, and often provided via a corporate foundation. While such budgets are occasionally appreciable, they are surpassed in every case, often by one or two orders of magnitude, by operational funds available to purchase services.

Thus, it is possible to increase the market for affiliates programs by providing certain services to these members in return for the fee or payment, and not considering the fee a contribution or "found money." This is important in recruiting industrial members, and even more important in retaining members from year to year. This underscores the need for a dedicated point of contact, who not only coordinates the services requested, but also keeps a careful record of the services rendered, furnishing tabulations of prior year services with each invoice for the subsequent year. Each year the invoice for the membership must be signed off within the company, and each year the point of contact within the company is asked "is this worth the money?" It is indeed to your advantage to provide back-up material for a ready answer.

Thank you.

MS. LEWIS I am pleased to introduce our next speaker, Dr. E. L. Jones, who is Manager, Dallas Research Division, Mobil Corporation. This unit is responsible for exploration and production research within Mobil. It maintains close association with Mobil's exploration production affiliates worldwide. Dr. Jones has had a number of assignments within Mobil Research and Development Corporation including exploration, production, and research, and is Manager of Exploration Research in Dallas, Texas. He has a Ph.D. in geology from the University of Oklahoma.

Dr. Jones will comment on the experience of his company with affiliate programs and universities.

MR. JONES: I can honestly say that as the last member of a panel, I have nothing original to say.

I will give you a different perspective on university-industry relationship. What I have to say is in terms of the exploration and production, so it is particularly focused on geosciences at universities.

I want to cover a number of the aspects of relationships between universities and the industry. I will use the terms "industrial associates" or "industrial affiliates" to mean those kinds of projects or programs that support a school's, an institution's, or a department's research effort. We don't try to direct these research programs but desire to support them. This can be considered, like John indicated, as a contribution.

In addition to that type of support, we have a number of projects which are funded by a group of companies supporting some specific area of research. We do give grants. We do hire consultants. We do have contract research with individuals in the academic world. All of these things make up the total relationship that I am going to try to talk about in the next few minutes.

A point of some significance is the fact that our "industrial associates" budget is probably less than ten percent of all the other forms academic research support added together. We are very selective in supporting undesignated projects, which in our system fall under the heading of "industrial associates".

Even though we are somewhat provincial in supporting predominately the geoscience department, we are not provincial in terms of the geographical areas we cover. For example, we have associations with Cornell on one coast and with Stanford on the other.

The area in which we are most comfortable, and most satisfied, is in the support of the individual research projects. We feel that this is the best mechanism to support university research from the industrial point of view and for transferring technology from the university to the industrial client.

We have had some associations that have gone on for a long time. For example, we have supported a geophysical research effort at one school for more than ten years. The effort has given us some ideas which we have pursued on our own. We do not look for a finished piece of technology from that project, but we get some awfully good ideas that we can incorporate into our own geophysical efforts. One of the things that they have done in this program is to have frequent meetings. They have a very comprehensive annual report; they hold workshops; they hold seminars. There is no doubt that the contribution is considered in terms of technology transfer, and we appreciate that. As long as the project gives us worthwhile ideas, we will continue to support it. It may go on long past my lifetime.

One of the points of concern in this kind of effort, is that many times the project is centered around one individual in the university. When that person goes to some other institution or retires, the project probably will terminate with his leaving. It is a fragile situation in terms of being very closely associated with one person, but at the same time it gives us value in terms of

the dollars invested. We like it very much. One of the things that I should point out is that, in many cases, these kinds of projects have actually been suggested to academic researchers by industry. We have asked people to put together a program to do certain things because we think that person is the ideal person to do so. So even at the initiation, we often have some input as to how things are done.

Now, in addition to that kind of activity, we do support a number of research contracts of various kinds. An observation from both the industrial point of view and the academic point of view is it requires dealing with a lot of specifics to get these types of projects arranged and running. The legal aspects of making the contract acceptable, both to the industrial participant and to the academic participant, are pretty formidable. Sometimes, I think if we could do away with the legal aspect of it, it would be a relatively simple thing, but we cannot. So, we do the best we can. In many cases, it requires months of negotiations among the lawyers. The researchers from the industrial and academic communities have no problem dealing with each other, but the lawyers sometimes do. It takes a lot of persistence to get these sort of things done.

Another of our contacts with universities is through grants. The recommendation for these grants comes from the working people, and so the best contacts in terms of acquiring grants really should be with the researchers and not with the industry foundation. What happens if you go directly to our foundation first is they call up people like me and say, what do you think of this? To short-circuit all of that lost time, deal directly with the researcher in requesting grants. In most cases, I guess, deans and departmental chairmen really like the research grants. I hear complaints from the individual faculty members that they only see part of the dollars that are involved. They see administrative costs nibbling away at the grants, and they complain to me about this. I have nothing that I can suggest to them. It is between the institution and the individual researcher.

Another thing that we do frequently, and I think John referred to this too, is to hire academic consultants. We try to supplement our staff by adding experts from the academic community to contribute to our own technical research projects. We also hire consultants who help us in our internal training programs. We have a fairly extensive in-house training program as part of our technology training program, and often there is someone in the academic community who is better qualified than a member of our staff to make the appropriate contribution.

A main point of this discussion is the industrial associates program, so let me make a few remarks about it. For the most part, we regard the industrial associates program as a grant. We try very hard to look at the prospective industrial association with a school in terms of, do they have programs in their departments or institutions or schools that are of general interest to us? We strongly lean toward the geosciences, and one of the guidelines of joining or not joining is in terms of that research area, or the research capabilities. Is it fairly well designed and is it of general interest to us? If it is, we will probably join because that is a fairly inexpensive way to maintain contact with universities.

We are concerned within the industrial world with support for the younger faculty who cannot go to the NSF for funds.

Another thing of real concern to us, as has been mentioned a number of times, is making our presence known on the campus for recruiting. Though we recruit primarily at the Ph.D. level for our lab, we do look at people with lesser degrees and often hire outstanding students who have a Master's degree or are getting a Master's degree. One of the things that some of the individual associate schools provide, which we really appreciate, is a directory of their students and of their research projects. This is one of the ways that we can determine which individuals are really of interest to us. Not necessarily just those doing the same projects that we are doing, but certainly those that are doing things related to what we are doing. These are prospective employees and we do appreciate the chance to get acquainted with them through the associates program.

We also use the industrial associates program to identify faculty for consulting or for contract research or for consortia agreements. We also identify projects which might be better supported through research grants from our foundation. The largest amount of money in our contributions budget goes to these kinds of unrestricted grants. Then finally, we do obtain data through these associations. They also give us samples. They are making observations and comments on topics in line with those things that we are doing ourselves. There can be an advantage to us in getting early access to the information that has been developed. This can lead to some kind of follow-up by our own staff or else additional support for the institution.

Another of the things I want to mention is that in some cases of grants, consortia or other contracts, initial contacts can, in turn, lead to other opportunities for interaction. As a case in point, I can refer to a marine institute on the U.S. Gulf Coast which we were supporting. That institute was testing some hardware that was of interst to us, and they asked us for additional funds for that test. We provided additional support outside of the regular relationship. The tests were very interesting. We took the idea and developed it in terms of our own needs. So what was support for research in a general sense became support in a specific sense. In a very specific sense it led to a competitive advantages for us.

Before I stop, I would make one or two additional comments to you about the mechanics of dealing with us in industry. One of the things that some of you know, perhaps some of you don't, is that we prepare our recommendations for grants about mid-year. So any time you are looking for some kind of support, it would be wise to contact us in early or middle spring. If you wait until the middle or the end of the year, the funds will already be committed.

Another thing that bothers management a great deal is that so many times researchers, as is the case in my own lab, promise to do much more than they can get to. It is harder to explain omissions than it is negative results. It is easier to justify not doing something because of a failure in an experiment than not getting to it.

One last comment. Make certain that in all of your industrial-university relationships that you work with someone from industry who has a common goal with the researcher in the academic world. There is no way that a program is going to succeed without some attention from both sides.

Thank you.

MS. LEWIS: The first question that we will take today is a very general question actually, and it certainly explores one of the themes which have been presented. It is addressed to any of the panel members, but I think I will address it first to the industrial representatives. "Given the barrage of requests to corporations for support of affiliate programs, do you have any advice on how to start such a program in the 1980's?" Dr. Ambrose?

MR. AMBROSE: Well, I tried to give some of that advice while I was speaking. First of all, make sure your approach is right. You should emphasize the services that you have to offer rather than your need for money. I might say that in the program I outlined, the point of contact has responded to every request that we have given to him in spite of some rather wild expectations by our staff. Second, he never has given us a definitive statement in writing of the services offered. It is always given orally. Third, he has never given us a definitive fee schedule. The fee was suggested by the Liaison Office, and it is adjusted every year to what they think the traffic will bear on the basis of the services rendered the previous year. They know that every year I have to justify expenditures for the program, so they carefully tabulate the services which they have provided. I also recommend strongly against loading this responsibility on some already heavily loaded professor, especially on a professor without tenure.

MR. JONES: One thing mentioned earlier this morning, was that if contacts with the industry groups have not been made and have not been firmly established, because they are brand new, make the request modest in size. No one wants to spend a whole lot of money on an unknown group of people. You will have a much better chance of getting a favorable response if you make the request relatively modest, at least in the initial stage.

MS. LEWIS: I am going to give an option to our other two panelists to respond to that.

MR. JOHNSON: I guess the only thing I would add to the response is that an administrator has to determine what is your institution going to propose as an area of expertise and what kind of contacts do you have in the industrial community. Take a very objective, cold look at the people, the people who are going to drive the process on the university side. Is the competence there? I think that is the issue that has to be considered. Can they actually market the programs themselves or are they going to ask you in three weeks to come back with thirty companies each paying ten thousand? If they do, you are not going to be doing business.

MR. GOLDSTEIN: Our university is in the process of starting two liaison programs this year. Our approach to both of these groups was to ask some corporate friends to come and to talk to us on campus about the possibility of starting these programs, and whether they would be interested in helping us structure the programs. Under such circumstances, with the contacts that we have, we were able to assess before we started whether it was possible to run the programs. We are moving forward in both programs.

MS. LEWIS: The next question is addressed to our university representatives. "Should one be concerned about providing financial incentives for faculty participation in liaison programs and if the answer is positive, how do you provide them?"

MR. GOLDSTEIN: I think we clearly provide a financial incentive for the faculty. They are already under great pressures. They have their research to do, their teaching and other responsibilities. To participate in programs of this sort, they need to have additional incentives. Our response is two-fold. First, we pay the faculty for any specific consulting interactions they have with industry from the funds paid to the university. Second, in all of these programs, we divide the excess revenue over expense, if there is any, among the participating faculty to use for travel and for building up their laboratories.

MR. JOHNSON: I second that. The only thing that has not been raised in all of this discussion is how do you capitalize the administration of these programs, and I think that is where Stanford, in particular, has been shrewd in saying that a portion of the income, the cash flow that comes into these affiliate programs, must be used to staff these administrative costs. It is important to realize that if you can build a program that involves eighteen or twenty-five companies, it is going to create some work overload. I think it is very important to accommodate and furnish support for this overload. Providing released faculty time by regarding the affiliate liaison respnsibility as a half-time teaching responsibility, or perhaps hiring secretarial help; are things that can help the program.

MS. LEWIS: This leads us into one more question. Someone would like to know whether or not the affiliate program should contribute to the university's indirect cost recovery through charges on the affiliate's fee.

MR. GOLDSTEIN: I think I will just comment on my predecessor's comments; all we charge is the direct costs. We have a program director for each one of the affiliate programs, and the affiliate programs must pay for that director.

MS. LEWIS: I have just one last question. This is a general one about the Ben Franklin program for Joe. "Who determines the projects to be funded under this program, and how are the dollars allocated?"

MR. GOLDSTEIN: In this program each advance technology center has its own way of screening the projects. In our particular center, the projects are developed between the various faculty and the companies that wish to participate. There is a written project submitted to the Ben Franklin Program. A Ben Franklin advisory board and an ad hoc advisory board of corporate and educational people review the projects and select those to be funded.

The interesting feature is that we select projects to be supported before we ask the State for their money. This year we didn't get all of the money that we asked for so there was a second review of projects proposed for support.

MS. LEWIS: We apologize for not having sufficient time to answer all of your questions. I would like to thank all of our panelists for their contributions this afternoon.

SESSION IV

PRODUCTS AND PROCESSES
FROM UNIVERSITY LICENSING PROGRAMS

MR. DUMMER: As we all know, more and more universities have responded in recent years to financial pressures and to a greater emphasis on technology transfer by taking steps to develop, or to expand, their own capabilities for patent management, either alone or in combination with external patent managing organizations. In addition, university licensing programs are dealing with a variety of new issues such as unpatented technology, tangible research materials, and the adequacy of traditional patent and copyright protection. The investment community is becoming involved in the realities of university patent policies and recent federal legislation as they deal with issues related to intellectual property in connection with new company start-ups from university research, and in research and development partnerships.

We now turn to Session Number 4, "Products and Processes from University Licensing Programs," and it is my pleasure to introduce your moderator, Earl Freise, Assistant Vice Chancellor for Research, University of Nebraska-Lincoln.

MR. FREISE: Thank you, George. If one were to ask the question as to the most commonly utilized method for technology transfer between university and industry, or even industries themselves, the answer received back would probably be that it is through licensing. Well, I would like to refer to licensing as the classical method of technology transfer. There is certainly nothing classical about the mechanisms and methods used to facilitate and undertake licensing. I am hoping our panel this afternoon will try to present to you an overview of what is licensable, the pitfalls and the strategies to do licensing successfully, and some of the innovative ways of developing a license.

Our first panelist will be Neil Reimers, Director of the Technology Licensing Office at Stanford University. Neil comes from extensive background in industry and went to Stanford in 1969 where he established the Technology Licensing Office. I have asked Neil to present an overview of what might constitute a licensable entity, how a university might go about setting itself up to do licensing, and how to operate an in-house licensing program.

MR. REIMERS: Thank you, Earl. First of all, I want to congratulate all of you for staying around. Serving on the last panel of the day after such a good heavy lunch, I anticipated that there would not be as big a turnout. Earl told me that my talk should be like Paris fashion; long enough to cover the subject, but short enough to hold your interest.

I am going to follow Earl's direction in this talk today. If there is anything I have not covered, I trust the question period will allow for amplification.

What Earl wanted me to first cover is to describe what do we, as a research university, have to license. Well, we have many things to license. One is computer software of all kinds. One specific example is a computer-aided design operating system. We have many other forms of what we call tangible research properties, such as biological organisms, plasmids, and so on. We may have new

instrument designs, chemical methods, chemical products, and on and on. There are many examples of successful licenses coming from universities. As an example, MIT has its memory core, Florida State has it Gatorade.

What types of intellectual property are used to protect those items? The classical type of intellectual property protection, (those that are also known as industrial property rights), includes patents, copyrights, know-how, show-how, trade marks, and trade secrets. These are not all as usable in a university environment as in a commercial environment.

In many of our licenses, we do not use patents. Many seem to feel that a licensing program can only proceed with patents; we find that this is not the case. Even when you can patent something, it may not be necessary or economically sensible to do so and the technology can nevertheless be licensed. For example, with the many hybridomas being developed at universities, I do not think in most cases, it makes economic sense to file patents.

At a university the largest source of research support leading to the development of licenseable technology, is typically the federal government. Earlier today we heard that the amount of research funded by a university's own funds is relatively small. I was very surprised at Lehigh's very high percentage of research support funded by industry. I think the national average for universities is around five percent of the total research funding. The yield that a university might expect, in terms of technology disclosures from its faculty and students from this research support, should be about one technology disclosure per million dollars of research per year. That was a number given at MIT some seven years ago and I find that, for us, it has held true to form. We are running above that now. We receive about three discoveries per week.

First, we have to put things into proportion. There are many forms of technology transfer from universities to industry. Figure 1 lists a few of these. I believe it was Edward David, President of Exxon in a recent talk who noted over twenty different forms. By far the most important form of technology transfer is the graduated student, who brings to industry that knowledge gained at the university. The others are not in any particular order, except that I do put technology licensing down toward the end. The direct education refers to Stanford engineering TV Network, which we use in Silicon Valley.

University technology licensing is a small subset of all technology licensing; most of the world's technology licensing comprises fully developed technology. Such technology has already been proven in the marketplace, and a good portion of the technology, in addition to the patent rights, is the know-how, the access to all the drawings, the documentation, the technical assistance, and so on that goes along with it.

But when a university deals with a company, we often have to acquaint them with university technology licensing, which is somewhat different than industry-industry licensing. For example, we need to explain that we do not have "corporate control" over our faculty or our students. The university will contractually transfer the intellectual property rights to cement the deal. The point is that while we will negotiate the transfer of the technology through a license agreement, the actual delivery of the know-how and the show how, particularly the show-how, will come through a separate bilateral agreement of the company with the students or the faculty, usually in the form of a consulting agreement or, often in the case of students, through their employment.

SOME FORMS OF TECHNOLOGY TRANSFER FROM UNIVERSITY TO INDUSTRY

The Graduate Student
Publications
Conferences
Direct Education
Consulting
Research
Industry Affiliate Programs
Technology Licensing

Figure 1.

SOME CONSIDERATIONS OF A UNIVERSITY LICENSE

NON-PROFIT
- MINIMAL KNOWHOW, SHOWHOW
- LIMITED IMPROVEMENTS
- PUBLIC SERVICE

LACK OF "CORPORATE CONTROL"
- FACULTY CONSULTING

GOVERNMENT RIGHTS
- GOVERNMENT LICENSE
- LIMITED EXCLUSIVITY
- REASONABLE ROYALTIES

PATENT INFRINGEMENT
- CROSS LICENSE

NATURE OF LICENSED TECHNOLOGY
- UNDEVELOPED, UNPROVEN
- BASIC PATENT POSITION POSSIBLE

Figure 2.

Let us quickly review some factors for consideration in university licensing. These are listed in Figure 2. First of all, as everybody here knows, the university is not-for-profit. We can't deliver all of the technological assistance that we would like to. We don't have the "corporate control" of faculty, as noted earlier; therefore, we have minimal know-how and show how. We will often have some know-how that may be in the form of a biological organism, or and it might be in a form of some documentation, perhaps a computer software program.

There is a limited amount of improvement rights a university can offer. Generally, the work that goes on at the university is funded by some external organization. I think almost all universities use "OPM"-other people's money-, to fund their research, and so you, in general, cannot agree to deliver improvements. It is very rare that you can, and it has to be very much limited to the specific people involved. One should get their specific agreement in writing to offer those improvements ahead of time.

Then there is a public service component. That is hard to define, but what we take into consideration in licensing agreements, is that we are a public service entity, and that our license agreement will often reflect that situation. The government's rights is a factor in the license agreement. The government obtains a license, for governmental purposes, allowing it to seek to have the particular project or process practiced for its benefit. Also, through treaties, the government license allows it to exchange the technology with another country. We find that is rarely a factor that affects the license.

We generally negotiate a limited exclusive time period, regardless of whether or not there is government funding involved. Because the technology that arises from university research is to benefit the general public and yet we want to give our initial licensee an adequate period of time to get a return on their risk capital investment, we seek to make the technology available broadly by non-exclusive licensing to other companies after some exclusive time period to the initial licensee. Most universities usually do not give a patent exclusive license for the full term of the patent.

Patent infringement is sometimes overlooked especially in an industry as fast moving as the electronics industry. A patent often doesn't mean a lot. A larger company will have many, many patents. A small company who is seeking to get into the marketplace with an innovative new product is approached by that larger company who says: "we would like to get a license for your technology and, by the way, we have a stack of patents on which we will give you a cross license because we know you are infringing at least some of them." However, since a university is not a manufacturer, it could care less about a cross license. Thus a university is in a position to enforce intellectual rights for the benefit of a small company.

However, the nature of university technology is typically that it is undeveloped, unproven. To illustrate the risk, of our first ten licenses, the first nine eventually were terminated without a product. The tenth one, however, is producing $200,000 per year; it is like four steps forward and three steps backward. There is a lot of risk involved in developing university technology. On the other hand, with a basic patent position, a company can get a significant headstart over its competitors.

Earl also asked me to talk about our licensing procedures. I will tell you how we proceed; although it is not necessarily recommended for others. We endeavor to maintain what we call, an entrepreneurial focus. While every situa-

tion is different, I will present the following as a typical situation as to how we evaluate a discovery. First, after receiving the disclosure, we meet with the inventors. Sometimes even before we have received a disclosure, we get a telephone call. In any event, our first step is to sit down and talk with the inventors about the technology. Of the ten or eleven people in the office, about seven are engineers. We seek to understand the invention, the fields in which it will be used, and to consider potential licensees.

We can generally make a preliminary assessment whether the invention is patentable or not, but that is a second order question. The first question is, do we have something we can market? To get a better handle on that, we then proceed to contact companies. I should mention that along the way we determine whether or not this invention is something we can license exclusively or non-exclusively. We prefer the latter, but it is rare with a university discovery since they usually take a lot of additional development, and, consequently, it likely will not be developed by going out non-exclusively. You need to bite that bullet (exclusive vs. non-exclusive) early on because you are trying to get companies to interact with you and help with your evaluating process; if you first tell them the potential license is non-exclusive, I do not think you are going to get much attention.

Contacting companies is part of our evaluation process. We invite them to campus; if they do come, we are a long way toward a license. We know a lot of companies. But we do still make a number of cold turkey calls on companies. We initially always want to make personal contact, rather than send out questionnaires or relying on a computerized invention listing service.

Then we can sit the company representatives across the table with the inventors to discuss the technology. Through these interactions, we make the decision whether to file or not. It is important in a university's form of licensing to have enthusiastic inventors. If you don't have enthusiastic inventors, it is really hard to move the technology along. As you have many other cases to worry about, it is probably not worth proceeding unless you have strong dedication on the part of the individual(s) who came forward with the discovery.

I believe Figure 3 will help illustrate the unique considerations of licensing at a university. It is an example of licensing computer software. The problem observed was that more and more research results were coming out in the form of computer software, not feasible for publication in a journal but adequate to turn over to another scientist. So what does the scientist do about this? Well, if the scientist decides to send out the research results broadly as software to everybody, this can be a fairly expensive proposition. But more importantly, instead of getting responses from other scientists about the nature of the science, the scientist gets questions about the software itself; what kind of core memory is needed; can you adapt it to this or that computer; things that relate to the running of the program, rather than the science. So the scientist may alternatively just send the software to only a few colleagues who the scientist knows may send him or her something in return. This option doesn't aid broad distribution of research results.

We also observed a lot of the software had significant commercial potential. So we came up with a three-tier system of software distribution. The first two tiers are under what we call our Software Distribution Center. We have two people handling software distribution.

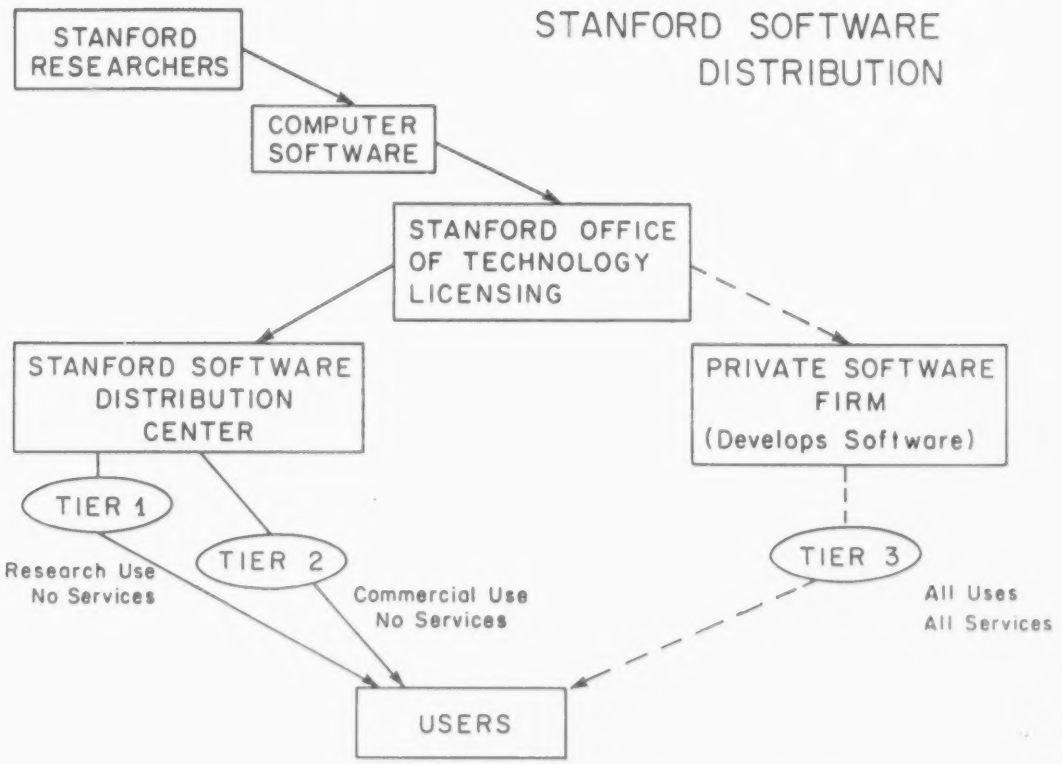


Figure 3.

It should first be observed when the software is sent out through the SDC in Tier one and Tier two; it is provided without service. Providing service would be an inappropriate role for the university. It is as-is, where is. The first tier is intended for scientists who pay only the cost of distribution. We have to determine what the cost of distribution is and then factor in the cost of our people in handling this. Typical charges are of the order of one or two hundred dollars.

The second tier distribution is to companies. They often can use the software for commercial purposes as it emerges from our laboratories. Again, we do not guarantee it works. It is as-is, where is. But we might price it at, say, in the range of eight hundred dollars to two thousand dollars. We are billing out around twenty-five thousand dollars a month through our SDC now. The SDC recipient cannot further transfer the software; they can only use it within their own laboratory, and they cannot harass our scientists or developers with respect to questions about the software. We try to answer basic questions, but beyond that no more. I guess you get what you pay for.

Tier three distribution occurs when users need fully developed software. We will approach a software company that licenses that software, develops it to a commercial stage, perhaps adapts it to other computers that are more popular in use, or adapts it to other operating systems or what have you. In many cases, the first customers of the Tier 3 licensee are the Tier one and Tier two licensees.

I think I am going to have to close here because of the time. So, quickly, if I can leave one message: in approaching a company, we look towards the collaboration. We try to develop approaches that focus on the collaboration between the university and the company in producing a new product for the public use and benefit, rather than focusing on, for example, the patent claims. If we are successful in that, regardless of whether there is a patent or not, there is a basis for mutual reward to the company and us.

Thank you for your attention.

MR. FREISE: Thank you, Niel.

Our second panelist this afternoon is Dr. Richard C. Cunningham, Senior Associate, Patents, Research Corporation. Prior to his association with Research Corporation, Dr. Cunningham was Vice-President for Research and Graduate Studies and Professor of Mechanical Engineering at Pennsylvania State University. Before his association with Penn State, he spent approximately eleven years as a research engineer with various commercial firms.

I have asked Dick to try and address the licensing potenial for a university by utilizing the services of an external licensing firm. Dick.

MR. CUNNINGHAM: Thank you, Earl. As background information, Penn State University ranks about number twenty-four in research expenditures--about $82 million a year. The main research campuses are at University Park, and the Medical Center at Hershey, Pennsylvania. There are nineteen other campuses; total enrolment is 60,000.

Penn State has utilized Research Corporation's services since 1954 for invention evaluation, patenting and licensing. My comments today will be concerned with the track record of this arrangement and case-study examples of licensed technologies.

Prior to P.L. 96-517, patent policy - for example a fifteen percent share of gross royalty income for the inventor - was influenced by Penn State's Institutional Patent Agreement with DHEW. Recently the inventor's share was increased to twenty-five percent of the gross royalty income and his/her college also received an additional ten percent.

My main objective is to identify three specific inventions, patented and licensed by Research Corporation, which has produced more than ninety percent of Penn State's royalty income in recent years. The first of these is a delayed-release mushroom nutrient. The licensing activity was first limited to Pennsylvania firms, without success. Then Research Corporation broadened its efforts to include the total U.S., and located a licensee in California with two essential ingredients; know-how in raising mushrooms, and money required to take it from the bench to production. Under the licensing agreement, more than three hundred thousand dollars was invested in R&D efforts during the first few years.

The second example is in the cardiac pacemaker field, including complete pacemaker designs and novel circuits. It resulted primarily from collaboration between Dr. Frank Tyers, a cardiac surgeon at the Hershey Medical Center, and Bob Brownlee, an electrical engineer on the University Park campus. They produced a stream of inventions in the 1970s. Intermedics Corporation licensed several inventions. Penn State agreed to loan Brownlee to the licensee company (on leave) and undoubtedly this accelerated the development of this invention.

The third example is a "cold flow", liquid ammonia fertilizing system. This invention by engineers in the College of Agriculture injects liquid ammonia into the soil, largely eliminating the loss of gaseous ammonia into the atmosphere. It is licensed to a division of the U.S. Steel Corporation.

There are a number of others that we don't have time to go into, but these are the most important ones that provide substantial money to Penn State and the inventors.

Figure 1 shows the results of the Penn State-Research Corporation patent program. The top line shows the five-year range of University-plus-inventor shares, which have averaged $241,240 per year. (There are no patenting or administrative costs and all of the University's share is dedicated to a faculty research grants program.)

INVENTION AND PATENT PROGRAM INDICES

THE PENNSYLVANIA STATE UNIVERSITY

PERIOD: 1980-84

	HIGH	LOW	AVERAGE
GROSS LICENSING INCOME PER YEAR (UNIVERSITY PLUS INVENTOR SHARES)	$373,131	$115,226	$241,240
DISCLOSURES EVALUATED BY RESEARCH CORPORATION (RC)	56	39	48
INVENTIONS ACCEPTED BY RC FOR PATENTING AND LICENSING	14	1	5
NUMBER OF ACTIVE (INCOME) PATENTS	8	3	5

Figure 1.

The next line shows the number of invention disclosures submitted to Research, ranging from thirty-nine to fifty-six per year. Acceptances range from 1 to 14 with an average of five a year.

Prior to the early 1970's, the royalty income was best described as minimal. About twelve years ago, Bob Custard, who serves Penn State as university patent counsel, and I undertook a revitalization of the invention and patents program at Penn State. Our objectives were to stimulate awareness of invention opportunities, to show to faculty University administration support of invention-based technology transfer, to assist faculty in recognizing their inventions and writing disclosures, and to get disclosures promptly into evaluation. We closely monitor disclosures and projects at Research Corporation and seek to maintain good relations with faculty inventors and administrators.

Experience shows that good communication is essential between the inventor and Research Corporation's assigned Associate, particularly during the invention evaluation process. The disclosure at the point of acceptance for patenting often contains more and clearer information than provided initially, as a result of conferences between the RC Associate and the inventor. The invention administrator stays on top of these developments.

In addition to on-campus invention administration, business-like negotiation of research agreements is a second key factor. Penn State's patent policy calls for University control of invention rights in accepting research sponsorship. Exceptions are posible, the most frequently encountered and best justification being the sponsor's contribution of technology to the investigation (e.g., patents or proprietary technologies). During negotiations, pressures from the company and the PI to give up inventions rights are commonly encountered. In our experience, faculty fears that funding will be lost unless invention rights are granted are groundless when a clearly stated - and flexible - policy is implemented.

The licensing cash flow at Penn State results from a mixture of relatively small royalty-generating inventions. (There are no blockbusters yet - but we are ever hopeful). The Figure 1 data make a convincing case for the effectiveness of Penn State's invention-based technology transfer.

In closing, it is important to note that a passive patent program - in contrast to Penn State's active invention administration - is not likely to produce good results. There are two death-and-taxes type reasons why active promotion is needed. (1) Most faculty accord low status to inventions compared with getting a sponsor, doing the research and publishing. (2) The long-shot odds against the successful commercialization of any one invention. Positive administrative support and encouragement of the invention program are essential to counter these inherent problems.

MR. FREISE: The third panelist is Phillip D. Junkins, President of SpectroSonex, Incorporated. Philip has degrees in law, engineering and business, and careers as a patent counsel and various administrative positions in both large and small companies. In 1983 he founded SpectroSonex Incorporated.

Our first two panelists gave, more or less, standard approaches to the licensing of university technology; that is the in-house type of program characterized by Neil's presentation, and the utilization of an external patent management firm for licensing as in the Penn State example.

Phil Junkins is going to speak about a recent innovation in technology transfer where faculty from the university are involved with developing a company to exploit the technology developed at the university and thereby develop a customer for a license.

MR. JUNKINS: Thank you Earl.

My presentation this afternoon is a short review or a case study of a Los Angeles based start-up company, SpectroSonex Incorporated. This company shortly after incorporation requested and obtained an exclusive license from a major technical institute, the California Institute of Technology. We were invited to participate in this conference at the suggestion of Cal Tech. The Institute, through its Director of Patents and Licensing, is well aware of the matters that I will discuss today.

SpectroSonex is a very small high technology California corporation. It was founded in July 1983 to develop and commercialize unique ultrasonic imaging technology; technology that had been reduced to practice at the Jet Propulsion Laboratories, a major NASA research center operated by Cal Tech. Ultrasonic imaging is one of the several imaging techniques that make up the field of medical imaging.

The idea of founding SpectroSonex was spawned by three individuals; two senior scientists employed by JPL and myself; a Los Angeles business consultant and patent attorney. Its interests are summarized in Figure 1. The two JPL employees were fully aware of the JPL-Cal Tech imaging technology through their employment, and they knew of a number of basic patents assigned to Cal Tech that protected this imaging technology. Our small group determined that it had three basic needs: a patent license from Cal Tech, an R&D plan, and a business and funding plan. We believed that satisfaction of these needs would lead the company into the business of developing preproduction prototypes of medical imaging equipment and, thereafter, the business of manufacture and sale of medical ultrasonic imaging equipment.

SPECTROSONEX INTERESTS

- FOUNDERS OBJECTIVE
  - To Commercialize Unique Ultrasonic Technology
- ESSENTIAL NEEDS
  - Patent License From Caltech
  - Research and Development Funding
  - Business Development Funding
- CORPORATE BUSINESS
  - Development of Pre-Production Prototypes
  - Manufacture and Sale of Medical Ultrasonic Imaging Instrumentation

Figure 1.

Cal Tech's interests in granting a license under the basic patents relating to medical imaging technology, as expressed to SpectroSonex during our meetings and negotiating sessions were: one, recognition for a contribution to the nation's health programs; two, realization of early commercialization of a unique technology; and three, development of a new revenue source. These interests were reflected in the finalized license agreement.

Cal Tech as a relatively small but highly respected technical institution, but is rather well organized to handle the transfer of technology and patent rights from its university and JPL settings to the commercial world. The principal contact with the institution, relative to licensing of inventions, is the Director of Patents and Licensing. This office is held by Mr. Edward Ansell. The Office of the Director of Patents and Licensing publishes a catalog entitled "Patent Properties Available for Licensing". The current catalog lists over five hundred patents categorized as to fields of interest. Substantially all licensing negotiations are carried out through the Director of Patents and Licensing. In the case of SpectroSonex, the first and subsequent drafts of the license were prepared by the company. The principal reason for this approach was that we wanted a short turnaround time for review and discussion of these drafts.

When the license terms had been reasonably well established the internal review process commenced at JPL and Cal Tech. The various groups that reviewed the agreement terms included: the technical group that was involved at JPL with ultrasound technology; the program administration group at JPL; the personnel department at JPL, in view of the fact that two of the principals of SpectroSonex were JPL employees; the overall administrative group at JPL; and finally, the Office of the Vice President for Finance at Cal Tech. Review was made as to the technical soundness of our proposed development work to bring the technology to commercialization. Issues of concern were: conflicts of programs and license rights; conflicts of personnel interest; financial return to the Institute; and in the case of SpectroSonex, as a start-up organization, its financial viability. I want to mention that the inventor was also asked for his opinions as to technical matters. He was part of the review process at JPL.

It may be of interest that at Cal Tech the inventor has the option of receiving fifteen percent of all revenues from a license involving his patents, or he may elect to have fifty percent of all revenues assigned to his research group. The final decision as to the grant or non-grant of a proposed license rests in the hands of the University's Patent Management Committee comprised of the Provost, Vice President for Finance, and General Counsel. Figure 2 summarizes the events leading to the license agreement.

As it has been made somewhat evident by my foregoing comments, it was the scientists at the Jet Propulsion Laboratory who recognized an opportunity for the further development and commercialization of a unique package for ultrasound imaging technology which was under final proof of concept experimentation in the Laboratory. The development program at JPL was within six months of completion. A proof of concept imager had been built and was nearly ready for clinical tests. However, further funding was not going to be available. The university owned outright the patents covering the technology. Our small group reviewed the patents and the employment contracts of the two senior scientists, and then decided to form a corporation. Our approach to Cal Tech in late July of 1983 was by a letter of inquiry as to the licenseability of the patents. The letter was directed to the Director of Patents and Licensing. An initial meeting was held with the Director of Patents and Licensing, and the principal issues discussed

EVENTS LEADING TO LICENSE AGREEMENT

- RECOGNITION OF OPPORTUNITY
  - Completed R&D Program and Prototype
  - Caltech Patents
  - Opportunity Group
  - INCORPORATION
  - APPROACH TO CALTECH
  - INITIAL LICENSE DRAFT
- MEETING WITH KEY UNIVERSITY OFFICIALS
  - NEGOTIATION OF LICENSE TERMS
    - Field of Use
    - Monetary Consideration
  - Caltech/JPL Review Groups
    - Technical
    - Management
  - Conflict of Interest Problem & Resolution
  - Written Presentation to Caltech
  - Submission to Patent Management Committee with Recommendation
  - Patent Management Committee Meeting and Approval

Figure 2.

at that meeting were the field of use that we desired for the technology; other licensees under the patented technology that were in existence at that time; and our request for exclusivity for our field of use and interest. An agreement was reached with the Director of Patents and Licensing relative to the preparation of the initial license draft and drafts thereafter. Again, I want to point out that we were interested in drafting the agreement because we wanted to set the pace for negotiations, and we wanted to establish the first definition of field of use. Within a months' time, first and second drafts had been prepared and reviewed by the Director of Patents and Licensing, and the General Counsel was apprised of SpectroSonex's interest. A meeting with key university officials was held at the end of Spetember, and at that meeting the scientific founders and owners of SpectroSonex were introduced for the first time to the General Counsel and the Director of Patents and Licensing. At this meeting, there was discussion of the matter of conflict of interest, and it was agreed that the matter had to be resolved between the university and the scientists. The university officials were particularly sensitive to the conflict of interest problems in view of the then-current publicity concerning another faculty member's involvement with a commercial organization. It took approximately two months to conclude negotiations of the final license terms, including a satisfactory field of use definition and the magnitude of monetary considerations flowing to Cal Tech.

The Cal Tech and JPL review groups were appropriately involved in the problem of conflict of interest and it was resolved internally within the Cal Tech and JPL organizations. Our formal written presentation, which in effect was a petition for a license, was submitted to Cal Tech through the Director of Patents and Licensing in mid-November of 1983. The written presentation, as well as the recommendations of that office, were submitted to the Patent Management Committee during the first week of December, and on December 13, 1983, the proposed Cal Tech/SpectroSonex licensing agreement was approved and executed.

Throughout the entire license negotiation process, and in the written presentation at Cal Tech, SpectroSonex, as a start-up company, recognized the need to establish licensing credibility as outlined in Figure 3. We consistently emphasized the technical capability of our senior scientists and their standing in the scientific community. We also emphasized the qualifications and standing in the medical community of our medical consultants, and we were able to convince the JPL and Cal Tech review groups of the credibility of our company to perform the R&D, which would lead to early commercialization, production, and marketing of imagers. It appears, based on hindsight, that our broad knowledge of the ultrasound imaging marketplace and our realistic sales projections helped convince Cal Tech that our company's proposed plans were credible.

Figure 4 presents some of the terms of the final agreement. Under the heading "Field of Exclusive Use" are two items: SpectroSonex medical imaging and the prior licensing of audio systems. Obviously, our agreement did not get into the matter of audio systems, but our field of use definitions required careful construction in view of prior licensing in the audio systems field. Consideration for the licensor involved an initial payment, minimum annual payments and earned royalties on sales. The development efforts by the licensee were set forth in some detail in the agreement; for instance, the goal of coming out with commercial products. The development plan included budgeted expenditures and performance milestones including the sale of the first imager. Confidential reports are required and are prepared quarterly. They cover both the technical and financial aspects of the project. Obviously, other standard terms and conditions of patent licenses are included in the agreement.

ESTABLISHMENT OF LICENSEE CREDIBILITY

- Senior Technical Personnel with High Standing in the Scientific Community
- Outside Scientific and Medical Consultants
- Business, Legal and Financial Personnel and Advisors
- Unique Capability to Perform Fast-Track R&D Leading to Commercialization of Technology
- Market Knowledge & Realistic Sales Projections

Figure 3.

PATENT LICENSE AGREEMENT CALTECH: SPECTROSONEX

- FIELD OF EXCLUSIVE USE
  - Spectrosonex - Medical Imaging
  - Prior Licenses - Audio Systems
- CONSIDERATION TO LICENSOR
  - Initial Payment
  - Minimum Annual Payments
  - Earned Royalties on Sales
- DEVELOPMENT EFFORT BY LICENSEE
  - Goal - Commercial Products
  - Development Plan
  - Budgeted Expenditures
  - Performance Milestones
- REPORTS
- OTHER STANDARD TERMS & CONDITIONS

Figure 4.

At the present time, SpectroSonex is eight months into its planned development program, and the company believes that its goal and objectives are being achieved.

Thank you.

MR. FREISE: Our final panelist is Dr. William Davis, who is the Director of Licensing, Pfizer, Incorporated. Prior to joining Pfizer some eleven years ago, Bill Davis had been employed both in industry and private practice in the field of veterinary medicine. I have asked Bill to try to balance the university presentation with some words of wisdom of the do's and don't's of licensing from the industrial perspective.

DR. DAVIS: Thank you. I want to commend Ed MacCordy and the people who put this program together. They have done a great job. When Ed asked me to speak, it was shortly after I had made a one and a half hour lecture with a two-hour workshop, in St. Louis. Ed said to just talk about the same thing. If everybody condensed their presentations of two or three hours, to fifteen minutes like I have been asked, it would be the equivalent of a five-hour college course for one full semester. Spread out over 18 weeks it would be a little easier to take. On the other hand, I have to admit that the program committee was very sensible, because had they put me on the program this morning with Earl Cilley, you would have had the long and the short of it before lunch, and it would have been all over.

I have been asked several times what my position is at Pfizer. I had not really intended to say anything about it, but since I come with a series of biases and perspectives, it might be worthwhile to take two minutes to talk about that, even though my time is short. The Licensing and Development Division at Pfizer is a separate, free-standing division with nine professionals who have the total responsibility for identifying, evaluating and acquiring technology from outside sources; most of it comes from other companies. Pfizer is a four billion dollar company with five different businesses and we service all these businesses. Half of our products are either licensed products, produced by a licensed process, or they are sold in a licensed formulation. This is in addition to a three hundred million dollar a year research program, which alone simply cannot keep up with the growth requirements of the company.

By default, I have undertaken activity in the university sector. I find it very enjoyable, but over the years, I have identified a few things that I think might be helpful for you to know, and I would like to relate these to you this afternoon. For those of you whose position is so lofty that you never have to really negotiate or get into the trenches with people like myself, you might learn some things that will help your subordinates do their job. For those of you who do have to do it, you may hear some familiar things and my telling you will simply support you. I am the anchorman. As a kid I was a pretty slow runner. I was always the last one to get back, but always the first one at the table.

I want to address three topics which, to me, are important to this whole process. I want to back off and think about an invention moving through development, production, introduction and sales in the marketplace. I think it is important that this perspective be maintained. It has been alluded to already today, but I think it is important that it be maintained throughout.

My presentation will lack some continuity because I am hitting the highspots. I have picked some things where I think improvements can and should be made, and I am leaving out the things that are self-evident. The three topics that I do want to address are: how do you attract good partners; what kind of relationship should you expect; and what are the difficult issues, the sticky points?

I am going to stick to my own agenda. I will flip through it very quickly, and if there are questions or you want some expansion, we will try to pick these up during the question and answer period. Or I am good for a steak if somebody wants to go out for dinner for a longer discussion.

The first step in identifying a good partner has absolutely nothing to do with the partner. It has to do with your responsibility first, namely, establish a proprietary right. That's with yourself. Patents, trademarks, copyrights, are the legal ones but don't forget trade secrets, know-how and show how. If you are going the trade secret route, that means that at the very outset, everyone who is involved must recognize that the only way it has any value is to maintain its secrecy. That means no publication, no disclosure, no commitments and it also means that if a graduate student leaves and has it in his or her head, that somehow you have to cut them off from taking it to a competing firm. I do not know how you would do that, and that's one reason why I think that know-how technology coming from universities is difficult to transfer.

Another thing you should do early on is to define the total technology. What is the total technology, the total package that you can offer industry? Then when you get ready to go outside, construct a non-confidential disclosure. This is the sales pitch. Flip through the entire scenario. What are your expectations, what is it going to require to take that product to market? What will the product do in the marketplace? Initially, industry doesn't really care what it is or how it does it, but what they need to know is how will it compete in the marketplace and why should it be of interest. A handful of objective comparisons--hard numbers comparing the new product, the new concept, the new chemical, the new molecule with existing products--is worth more than all the other materials that you could pull together. Put in a big notebook. I am talking about a handful of data that are generated comparing your new invention with something that is already in the marketplace.

Along about this time, you will need to develop for your own use, an outline for commercialization, plus the research required, the development required, the skills, the registration needed. I come from the pharmaceutical industry, and registration is a big thing. Additionally, information on production, marketing promotion, and finally sales and support is desirable. Identify the whole list of things that are required and identify what are the key issues. Is it going to require registration in dealing with the FDA? These needs, in time, will help you identify the strengths that you must look for in your prospective partner. You should identify several candidates and your inventor or your principal investigator, is probably your best source for doing so, because he will know who is active in his field. Chances are, he has already consulted with them or knows them in some way.

When you get all of this done, then you are about ready to go out and do a selling job on your best prospective partners, and I would really recommend that every university who intends to seriously market new intellectual property in this way should have a marketing person, a salesperson on their staff to do this. This individual needs a technical background. As has been said several times during the day he or she needs to understand the technology. The individual must have the respect and the confidence of the faculty members so that he or she can talk to and get information from them. The salesperson has to know his/her way around the industry and has got to set about establishing a dialogue. Of the

fifty or so licenses that have been written at Pfizer since I have been there, only once did we write a license, where we identified the technology before we identified the people. In every other case, there has been an up front dialogue with the inventors established before we ever identified the project.

One of the next things that should be done once you have a non-confidential disclosure, one in which your sales pitch is sort of built in, is to start out with two or three prime companies. Your salesperson should establish a network, as Neil Reimers referred to, of two or three people that can be called and presented with this new idea. Describe it briefly. Is there a place for it, or are we just whistling Dixie? This kind of thing really should be done before you make any commitments to the extensive process of getting patents. While we are talking patents, don't forget overseas patents. In the pharmaceutical industry, we cannot afford to develop a product that would be protected in the United States only. So start the process early enough that you can still get those foreign rights protected.

Very early in the game, you are going to want to put your principal investigator in touch with your potential partners. Do a little coaching. Tell this individual what you want said. Scientists, of course, always think their invention is worth a million dollars. They want to tell everything about it all at once. They all want to do the hard sell, and they all get frustrated if everybody doesn't understand them. So do a little coaching. Do a little practicing. It may be wise, if you can't control it, not to put him into contact with the recipient until you have a secrecy agreement in place, because once the inventor has disclosed it, it may be hard to go back and get a secrecy agreement.

Secrecy agreements can be sticky but are fairly easy between the university and industry. You need a definition of the subject matter. There must be a time limit; no industry will ever accept a secrecy agreement with no time limit. You should put a time limit on the evaluation period. If it's positive, it's going to take a lot longer, but it can always be extended. If it's negative, it's going to push the evaluator to that negative decision so that you don't have to wait around for six months or a year to find out they don't want it.

There are some things I would suggest you not do when you are trying to market technology. Don't send descriptive letters blindly to a whole lot of major corporations. If the man at the other end knows you personally, the letter is going to be read, and attention is going to be paid to it. Chances are it will be forwarded to someone for whom it has some meaning in the first place. However, a lot of letters come in that really make no sense at all, and they are just a distraction. Don't insist on a secrecy agreement initially. We look at six or seven thousand new ideas a year within our division. We write 250 or 350 secrecy agreements. The shear magnitude of administering this many agreements is difficult, to say the least. If somebody comes along and says we have a great idea, but we don't tell you about it until you sign this piece of paper, we are likely going to turn you down. Don't give away the store right away. Talk first about what the product will do for the company. Don't tell all you know immediately, keep the information coming.

Don't establish a situation where one industry is being pitted against another. I think that it's important that you approach three or four candidates, give them all a shot at it, but then before you go very far, pick your best partner, and deal with them. Don't send it more than once to a given corporation. There is nothing that frustrates me any worse than for someone to send me

new technology, for me to go through all the processes of evaluating it, arriving at a negative answer, and then find two weeks later that the same university has sent the same letter to the Director of Research, and the review process has started all over again. Nothing will kill a project, nothing will kill a university's reputation any quicker than to do that two or three times.

Research project catalogs have been mentioned. They are fine, but they are not good selling articles. Don't expect me to go through a research catalog and pick out projects that I think are going to lead to licensable inventions. It just doesn't work. Don't expect a lot of enthusiasm and a positive response for nothing more than a concept. Get some hard numbers in hand. Don't, above all, and at this point I feel like a good friend of mine who periodically gets theatrical and pounds the podium, don't adopt an adversary point of view with a prospective licensee. The adversarial postion is ingrained in the legal profession, and the lawyers will kick me in the shins for this but I am sorry. The easiest way to avoid the adversarial position is to keep the lawyers out of it until you get your position established. If you have a lawyer who can lay that position aside, fine, let him in, otherwise wait until you are ready for a written contract.

What are you going to expect? The most common thing is that you are going to be looking for a grant for more work. If you are looking for a significant grant, you need to be prepared to establish and maintain the proprietary rights. This means giving up the right to publish right away. You probably will need to give up a right of first refusal, and you must be prepared to really negotiate in good faith for an exclusive or limited field of use license. If things really move well down the line, or when they do after that first research grant, then you start talking about an option license. You never talk about an option without the license. An option is meaningless unless it has a license tied to it, or unless there is some built-in protective mechanisms in the options, which can be done, but it's not easy.

In any of these, you need to identify who is responsible for what, what are the types of conditions, what are the resource commitments, and what are the performance requirements. I don't mean best efforts. Best efforts is like agreeing to agree. It has absolutely no meaning. Don't ever do that if you can avoid it, and if somebody trys to get you to use it, tell them to go fly a kite. State "a hundred thousand dollars a year in research funds"; state "a laboratory of ten thousand square feet, equipped thus and so"; state "a professor and two graduate students"; state whatever it is that your commitment is going to be or what the company's commitment is going to be, and I am talking now as if this is a cooperative venture because I really hope it is. That's the way things move most quickly. When it gets to the point where you can really identify the scenario right out to the end, then you can think about a license.

You need to think about the cost of research, particularly if you are looking for that grant. Prepare a work plan and use realistic time and cost estimates. Let's talk about overhead charges. We fuss inside about this all of the time, and it really just won't go away. Be prepared to itemize your overhead charges. Be prepared to discuss and disclose them so that if we are going to pay for those overhead charges, at least we know what we are paying for. There is nothing more frustrating than to be told yes, you absolutely must pay overhead charges, and then find out that my buddy down the street has gone to the same university, and worked a deal where no overhead charges were made. Be consistent.

What are some of the difficult issues? Universities typically are not organized for licensing. Establish your policies and guidelines. Identify the authority required. Who is going to sign that license at the end of the day? Develop a marketing capability, selling not only to the outside, but selling to the inside as well, because you are going to have to convince your inventor to bite the bullet on some tough things. Assume some risk. Universities don't like to assume risk, but if you really want a big payoff at the end, you must assume some risk.

What are the conflicts of interest that may occur? Identify your faculty's associations and their prior commitments; identify the staff that will be working on the project; identify the graduate students and whether or not they have already signed up to go to the competing company. Define and disclose to your potential partner all outside grant support, particularly where the government is involved.

The biggest hangup is identifying the economic value of the license, and we all think in terms of royalties, but we need to think in terms of the total license,too. You need, first of all, to put into perspective the invention as a part of the whole process of innovation. How big a part does the invention play in terms of going all the way to the marketplace. Generally speaking, for an exclusive, no-risk license, we think in terms of the twenty-five percent rule. Twenty-five percent of the net profit before tax goes to the inventor, twenty-five percent to the developer; another quarter to the producer and the final quarter to the seller. I have actually worked through an analysis which illustrates this and can share it with you. You have to include a couple of other factors such as the time value of money. Again, in the pharmaceutical industry with a ten to twelve year lead time, that's a real problem. You have to include the technical risk and the commercial risk. What is the chance that your PI's inventions will make it technically, and if it makes it technically, what is the chance that it will be a commercial success? You work all of this back to a dollar value, and then you can either share that risk where you take part of it as a royalty. You can sell it outright and walk away from it. There are any number of ways that you can divide it up, but figure out how you are going to approach it. Do the formula, and then negotiate and argue both with your inventor and your industrial partner, as to exactly what that final numbers should be.

The real challenge of technology transfer is the fact that each case is unique. No two cases are going to be the same, and no case is going to be without its problems. The solution to the problems and the success of a licensee goes to those who have imagination, confidence and a lot of persistence.

I wish you all good luck, and I would like to do business with you.

MR. FREISE: Thank you very much. We have enough questions to last another hour and a half. We will respond to some selected questions.

One issue that seems to provoke a lot of questions, or a lot of people are interested in, is directed to you, Phil. Mainly, it has to do with elaboration on the experience with Cal Tech's conflict of interest concerns, and what were the terms and conditions under which the inventors would work with your company and still retain their positions at Cal Tech and JPL?

MR. JUNKINS: Well, the problem was pretty clear cut. Two of the three founder/owners at SpectroSonex were also scientific employees at JPL. Therefore, they were part of the Cal Tech staff. The problem was resolved because the technology had reached the point of proof-of-concept, and the particular ultrasound program at JPL was near termination. In fact, the funding contract terminated in mid-January of 1984. The employees in question agreed to refrain from consulting until the day that the contract expired. The underlying patents, the patents that were involved, were the sole property of Cal Tech. They owned them outright and the inventor of the licensed patents was not an owner of SpectroSonex. A prior license had been granted under the patents for use in the audio sound area. The university determined that the scientific founders could be owners of the company, could be board members (but not officers) so long as they were employees of JPL. They could act as senior consultants for the company while employed by JPL, but that consulting activity must not ever interfere with their duties and responsibilities at JPL, and no JPL facility or equipment could be used to further SpectroSonex's interests.

MR. FREISE: Thank you. I would address the next question both to Niels and to Dr. Cunningham. It concerns the licensing of know-how or show how where a patent is not involved. For Niels, the question would be what percentage of the licenses from Stanford involve such know-how or show how, and for Dick's case, in working with an external firm, how do you handle examples of know-how or show how that are disclosed to you at Penn State? Niels, do you want to start this out?

MR. REIMERS: Well, we have not taken a look at the percentages. We license an awful lot of software. It must be well over fifty percent that don't involve patents.

MR. FREISE: What about what we would consider just know-how? Do you license any of that?

MR. REIMERS: Well, you could call plasmids and software know-how.

MR. FREISE: Dick?

MR. CUNNINGHAM: Software and the hybridomas that Niels mentioned are obviously quite new on the scene. Academia is feeling its way in this regard. I think it is a safe generalization that dealing in trade secrets is not the best course of events for universities. It flies in the face of the purpose of the institution, which is to discover and disseminate knowledge, but there is no question that certain technologies can only be handled in this way.

MR. FREISE: Thank you. Bill, would you like to comment as to the extent, in your experience, that you have licensed know-how or trade secrets from universities; do you ever get involved in that?

MR. DAVIS: Generally speaking, the know-how has in the past for us, been associated with patents, and it is rare that a total technology is included in a patent. That is one reason I made the comment earlier to define the total technology package, because it often will incorporate some know-how along with it. Of course, the know-how royalties can extend beyond the life of the patent. There is almost always a know-how element, particularly when it is a cooperative venture, and if you have a continuing relationship.

MR. FREISE: Thank you. The next question is to what extent can you use a limited period of exclusivity with perhaps, say, a review period of some measure of performance by the licensee in gaining successful licenses. Neils, would you like to start off with that?

MR. REIMERS: Getting a period of exclusivity is often the only incentive available to encourage a company to invest its resources. I do not know if a more complicated response is required.

MR. FREISE: Dick, have you always gone with an exclusive period for the life of the patent?

MR. CUNNINGHAM: No, there is always a limited period of exclusivity, but the licensee may, and in a number of cases has, requested extensions of the period of the activity to provide an opportunity for both the patent service organization and the university to review the situation. Normally, the request for extension is granted.

MR. FREISE Bill, from your experience in negotiation if the period is to be limited, how does that industrial firm view this?

MR. DAVIS: We evaluate the potential license on the basis of a fairly comprehensive return on investment calculations, and if the exclusivity period is limited with no opportunity for extension, that is built into the calculation. If the ROI doesn't appear attractive, then that is a negative response. Especially, if we are planning to make extensive expenditures; taking the technology from its proof of concept state to commercialization, we insist on an exclusive license.

MR. FREISE: Thank you. The next question has to do with infringement. Is there any trend in cases of infringement of university-owned patents, and should a university pursue legal action if they believe their patent is being infringed? Niels.

MR. REIMERS: I can't say whether there is a trend or not, but I do think if you are going to be in the business, you had better stand behind your patents and enforce them. Since our licenses are typically exclusive, we work with our licensee, and we may jointly enforce the patent. But if we don't want to go jointly, then the exclusive licensee can enforce the patent.

MR. FREISE: Dick, is that your experience?

MR. CUNNINGHAM: Our agreements with the patent service organization includes the sharing of litigation costs if infringement does occur. Nothing happened in this area until about three years ago when we did encounter a clearcut case of infringement. The university agreed to share the costs of litigation, which over a three year period were appreciable, but it was well worth it. The patent was re-examined and we ended up with a stronger patent. There is no question but that the royalty income in the remaining life of the patent will outstrip the legal costs.

I think this is a situation in which an outside service organization can play a significant role. Most universities have neither the stomach nor the bankroll to take people to court in infringement cases. Research Corporation's reputation for stopping infringers is an important plus.

MR. FREISE: I would like to take Bill and then I will take Niels' comments.

MR. DAVIS: One of the advantages of an exclusive license, is that you can arrange with your licensee to undertake infringement prosecution, and it is to his benefit to protect the patents. With a non-exclusive license, it is almost impossible to transfer that responsibility or to rely in any way on the licensee to even support a patent infringement. The pharmaceutical industry lives by patents, and the university has always been sort of sacrosanct, but yes, there are some bad guys out there. I think we are probably going to see more infringement in the future. Research indicates that pharmaceutical companies are pressing for stronger protection especially since the advent of generics.

MR. REIMERS: In enforcing one's patent, consider the re-examination procedure. After you have gone through re-examination, you will have a much stronger basis on which to decide whether to go for infringement proceedings or not.

MR. FREISE: The final question I will address has to do with obtaining the confidentiality agreement before the university begins to discuss with the potential licensee the value of the technology that is to be transferred. Now, we heard Bill allude to the fact that from industry's point of view, they would prefer not to have that as a condition before talking to them. Niels, I would like to know your experience and then I would like to hear from Dick on his experience in working through the outside organization.

MR. REIMERS: Well, I find that sometimes if you approach companies insisting on confidentiality agreements, you end up talking to the lawyers at the company. That is one of the least productive areas to begin with. You try to get as far along as you can with the people that you want to sell on the technology. It might be the research people, the Director of Licensing, or the marketing people. At the appropriate time, you may bring forth the confidentiality agreement when you are exposing the details.

MR. FREISE: So you are suggesting that you start out slow and interest them, and when there is a strong interest, introduce the confidentiality agreement?

MR. REIMERS: If you need one at all. Generally, you can rifle in on a few companies if you know you are going to go exclusive and somebody is ready to go. You close out your contacts with the other companies and you just work with that one. You may never have a confidential disclosure agreement. You may just proceed directly toward the license.

MR. CUNNINGHAM: I fully agree with Bill and Niels both, that these agreements too early in the game may cause more harm than good, and should be used only when necessary. We have not talked this afternoon about the influence of the inventor on all of this. At the risk of exaggerating the situation, it seems at our institution that we have encountered those who range from early insistence on a confidentiality agreement before they will leak any information to anyone, even the university, all the way to those who wish to spill everything to the nearest listener, and thereby wreck the case.

SESSION V

NEW TECHNOLOGY FROM COOPERATIVE
UNIVERSITY/INDUSTRY RESEARCH AND DEVELOPMENT

MR. DUMMER: Good morning. Today we start with Session 5, "New Technology from Cooperative University/Industry Research and Development."

From our sessions thus far and from discussions with each other over the last day or so, it is obvious that cooperative R&D between universities and industry is not only increasing in magnitude, but also in terms of the variety of mechanisms involved. Collective industry support of single and multiple university programs, aided by recent clarifications of U.S. Anti-trust Law, has increased.

Company scientists are working in closer collaboration with university faculty and students, and are more in evidence on many of our campuses. More universities are using associated research foundations and institutes to interface with industry. And, as we know from the session on licensing yesterday, which will be reinforced in the sessions dealing with new company start-ups and investment company activities later in the day, greater attention is being given to commercialization of the research results.

How are these relationships triggered--from organized searches or from serendipitous encounters? By whom, industry or university? What opportunities are there for matching the specific interests of key individuals in a company and in the university? How valuable to a sponsoring company is prior and current government sponsored research by the principal investigator? Are agreements becoming easier to work out? These types of questions fall within the purview of Session 5. It is my pleasure to introduce to you your moderator, Allen J. Sinisgalli, Director, Research and Project Administration, Princeton University. Allen.

MR. SINISGALLI: Thank you very much, George. Good morning, everyone. I am very enthusiastic about being able to head this panel of experts. Our topic, New Technology from Cooperative University/Industry R&D, gives us broad latitude to discuss important trends.

This being the second day into the conference, our panelists have had a chance to think about some of the things that were said yesterday, and we did note there is a partner whose role has not been discussed as much as the university, the industrial, or the federal partner's role in cooperative ventures. I am talking about the state and local governments. We will have a chance to explore that relationship this morning in our panel discussion and we hope it will be of interest to you.

Before we take a look at that particular aspect of cooperative research, our first speaker this morning, Dr. Hall, Vice President, Corporate Research Staff from Xerox Corporation, will talk about cooperative research from the more traditional aspect of the large corporation and the individual university. Dr. Hall.

MR. HALL: Good morning. It is a real pleasure to be here and talk to you about Xerox Perspectives on Cooperative University/Industry R&D.

George Pake sketched the conditions for technological strength in his 1983 Ferguson Lecture at Washington University, where he said: "Inventions of ultimate technological and economic significance once could be made by intelligent, persistent thinkers with little formal higher level education. Edison, the Wright brothers and Henry Ford come to mind. Modern technological advance is a different story. Consider the transistor, the laser, or synthetic insulin...you don't find these associated with tinkering in a basement or a garage.... Thus, the modern R&D enterprise is inextricably linked with the research university, since it draws graduate students from the colleges. There is a great big E that comes before R&D; I shall refer to the E, R&D, macrosystem."

I am going to make a special point of giving the industrial perspective on the relationship of the educational role to these Cooperative R&D relationships.

The relative roles of government, universities and industry are familiar to all of us. Government is the primary source of university research funds, universities are the primary source of technologists for industry, and industry is the primary source of economic activity from which the government draws all its funds. My purpose today is to look closely at one of the secondary linkages in the E, R&D system, Cooperative University/Industry R&D. My thesis is that this link is small in its magnitude, but crucial to the overall health of the system. There is no doubt that today the United States has the best E, R&D system in the world. What is in question is our staying power, given the evidence that other nations seem to be shrinking our lead. If our adaptivity is impaired, it is only a question of time, and not much of that, until other nations seize the leadership.

Adaptivity or self renewal of the three huge institutions involved in the macrosystem is the competitive metric. Complicating the problem is the requirement that all three institutions have to find effective means of self-renewal that can be adopted without shutting down the system for repair.

Historically, universities exhibit the greatest capacity for self-renewal. We have some very interesting data on exactly how powerful they are in that. Several of the leading universities are indeed centuries old, older than any extant government.

The secret seems to lie with their practice of opportunistically creating new departments while recycling obsolete departments with great respect for tenure. Currently, there is growing concern that the pace of change may have become too fast for the deliberate processes of universities. In particular, the information age came on so quickly that universities have never led it, and indeed many are struggling now to establish a foothold in the information sciences for the first time.

American industry historically shows less individual capacity for self-renewal than universities. Dominant industries die out and new leaders spring up. But the American system of free enterprise is based on exactly that kind of reward and penalty for individual corporate renewal, and over the last two centuries has demonstrated the superior resilience of industrial free enterprise as a whole. New start companies are very much more an American tradition than new start universities.

To turn now to the third party in this great enterprise, the United States government exhibits great stability, being one of the older governments still in existence. This stability has led to the circumstance that our government practices self renewal by accretion of regulations. Despite decades of concern, and powerful moves to produce alternatives (I would remind you of the 1970 Commission on Government Procurement, the 1983 Grace Commission, the feeble attempts at sunset laws and so forth) progressive paralysis by red tape continues to be the main observable fact of change in our federal government.

Pragmatists today see decreasing hope for innovative leadership in self-renewal emerging from the government sector. On the other hand, there is growing hope that industrial flair for new starts can be coupled with university needs for new starts. If this happens, and if the federal government can promptly provide resources to these new university organizations, there may be a basis for more optimism about maintaining American leadership. Many corporations and universities are becoming involved. I will conclude my discussion with a short review of four examples of this new trend drawn from the recent practice of my employer, the Xerox Corporation.

Xerox has a long tradition of grants to universities. These have ranged from support for particular scientsts or research projects, to major gifts to selected universities. However, during the last 10 years, there has been a significant trend within the company to a new university relationship founded much more on joint research activity than on traditional industrial philanthropy. Four examples will be given.

Example one is the Center for Integrated Systems at Stanford. In 1980, Xerox participated in the early conceptual, promotional and organizational activities which resulted in organization of the Center for Integrated Systems at Stanford University. The Center focuses on the integrated circuit and software sciences; it now has 20 industrial sponsors, a new facility, and an exciting research program involving many departments of Stanford University, all 20 industrial sponsors, nearly 100 faculty, and approximtely 500 Ph.D. candidate graduate students. The principles of this consortium are a model for equilibrating the public trust of a great university with the private interests of the sponsors.

Example two, again is a collaboration involving Stanford University, the Center for Study of Language and Information, or CSLI as some call it. In 1983, Xerox participated with the System Development Foundation, Stanford University, and SRI in creating the Center for Study of Language and Information at Stanford University. Major funding is provided by SDF. Xerox Corporation provided much of the computational environment through multiyear grants for computers and software valued at several millions of dollars. Xerox has several members of its corporate research staff deeply engaged in the center's technical program, which involves the study of the mathematical foundations of natural and computer languages. In layman's language, the Center's most ambitious hope is eventually "to understand what 'understanding' is".

The third example is of a different pattern than those. In 1984, Xerox established a program of grants of computer equipment and software to fourteen universities. Grant recipients were selected competitively from more than 35 solicited grant proposals received by the company. Winners were selected on the basis of criteria that included research and teaching objectives as well as proposed technical contributions to network standards and productivity enhancement

of system development. 1984 grants involved a total value exceeding 10 million dollars. Xerox expects to extend the program in 1985 and successive years, based on results from the initial program.

My fourth example is one where, in the light of the splendid luncheon discussion yesterday, I need do no more than identify the Semiconductor Research Corporation, which indeed is a major different form of collaboration between a great many industrial firms and a very great number of universities.

In summary, I would look back at these four examples and call your attention to the emphasis on the educational role of the universities in each and every one of them. We think it very important to keep a focus on the primary product of the universities, that is, their teaching capabilities. The R&D is an enormously valuable, stimulative, and synergistic by-product. The transferable technologies that come out of that are indeed frequent and fortunate and happy accidents. But when one makes grants to universities, you can be absolutely certain of your reward, if you believe that hiring competent, well-trained technologists from that university is a sufficient compensation.

I was very pleased to note yesterday that Glen Bandy of Texas Instruments held this same perspective. I join his advice to those of you in the universities and say integrate the teaching and the research roles of the university. That's a very important thing to do. The university as a research institute is just another competitor, but the university as a combined teaching and research institution is without competitors.

In conclusion, I want to state that the three-way partnership has proven its effectiveness in bringing us national leadership. We all understand the very stressful challenge of continuously modernizing ourselves without shutting our system down. I have tried to point to these instances where the relatively free capability of industrial firms and universities can lead to new startups, which then, in the event that they prove to be successful, could qualify for substantial continuing federal funding. This is the way in which all three partners can, in my opinion, participate in insuring our continued world leadership.

MR. SINISGALLI: Thank you, Dr. Hall. We certainly appreciate your remarks on the three-way partnership in research and, specifically, the attention you paid to the educational mission of the universities. It's quite comforting for those of us in the university community to hear those remarks because it's near and dear to our philosophy also.

As I mentioned briefly before Dr. Hall's talk, the three-way partnership of industry, university and federal government has been complicated somewhat by the fact that regional, state and local governments now see collaboration on research as a way of stimulating employment and growth for state and local economies. This infusion of new interest has generated much excitement. For example, my State, New Jersey, is the home of many large R&D facilities of some of the nation's largest corporations. Its governor asked experts from industry and universities to sit down and to think about technology, research and growth in the state. The governor's commission on research was chartered to produce a blueprint for the future. While we were working on the document, we looked across our rivers to some of our sister states. We looked to Pennsylvania and New York as representative of two places where much progress was being made in the areas that we were concerned with.

This morning, Max Kraus, who has worked for the Electro-Nite Corporation in Philadelphia since 1969, and is currently Vice President and General Manager of the Metals Division, will talk to us in greater depth on the Ben Franklin Partnership and other mechanisms for growth used in the Greater Philadelphia area and the State of Pennsylvania.

MR. KRAUS: Thank you, Al, and good morning. When I arrived yesterday, I found that you had already heard the broad outlines of the Ben Franklin Partnership in Pennsylvania, so I will change my remarks a little bit to talk somewhat of that, somewhat of what we have done in Philadelphia, and a little bit of the perspective, as I see it, as the general manager of a medium-sized company doing about $50 million in world-wide sales; manufacturing sensors for the iron and steel industry and trying to develop new products to bring to an industry which obviously has a lot of troubles.

The work done in Philadelphia is an outgrowth of work that started with the Entrepreneurial Center at the Wharton School, the PennTAP, the Technology Assistance Program of Penn State University, but really got under way in 1981 with the Philadelphia Past, Present and Future Program, which looked at Philadelphia as it was entering its fourth century and tried to assess its strengths and its weaknesses. The results were a number of documents such as this, the result of panels that looked at urban renewal, at technology, at transportation and so on. In the technology area, the technology panel recommended the use of innovation conferences to stir the awareness of the importance of new technology for economic growth, the establishment of a one-stop innovation center to accelerate entrepreneurial activity, the creation of an entity to aid development and marketing of promising inventions and a technology evaluation group to match investors with inventors, together with research and development cooperatives to advance the use of new technologies by Philadelphia based industries.

The Chamber of Commerce reacted to this by creating a small group, which I had the opportunity to head, to look at ways to combine the awesome academic talents of the Philadelphia area with industries who in many cases were not using them. People went to SRI; companies came to the University of Pennsylvania, but a lot of the medium-sized companies in the area simply did not take advantage of what the academic community had to offer. When we first talked to companies, they wanted products. They wanted to have something that they could put into production and make some money next year. We had to reject that because the academic output does not result in someting that you can commercialize instantly.

Instead, we put together a committee and talked to the deans of the engineering schools and the physical science departments in the Philadelphia area and along with some representatives from industry created what we call the Resources for Progress. Our first program, held last fall at Drexel University, was structured to provide a showcase for the local institutions to meet with industry. We were able to get one hundred and twenty five industry representatives together with thirty eight engineering and physical science departments of ten colleges and universities. We invited everyone we could think of in the Greater Philadelphia area. Those who responded by paying a $25 or $35 fee, received a technology packet which outlined the patent policies, the research interests, et cetera, of the Philadelphia universities and encouraged the individuals to come to Drexel for an afternoon "show-and-tell" presentation by the universities. We set up booths and tried to put it on the basis of an industrial show with papers, and whatever displays the universities wanted to show. We

started the conference with a couple of lead speakers, the governor's technology advisor, et cetera. Then we broke up into groups and invited the university people to talk with industry and tell them what they had to offer. We got quite some favorable press from it and favorable results. But we decided that the universities were rather uneven in their abilities to show their wares. The university of Pennsylvania and Drexel University did a much better job than Widener, for instance, because they had more to show and they had more experience in how to do this.

Our next program, held last spring, was at Thomas Jefferson University, and was devoted to the biological and medical sciences. We structured a whole day program, with invited participants from industry and the universities. Industrial participants got 5 to 10 minutes to tell what they were good at and what they were looking for. Universities were invited to describe what they were doing. We created an atmosphere where they could talk together. As I say, it was a whole day program. We again had some luncheon speakers and then we broke up in the afternoon for some wine and cheese and the opportunity to talk. We found that we didn't create 10 new businesses, but we created a hundred new linkages where the local businessmen are beginning, I sincerely believe, to have some way to get into the universities and look at it as not being some awesome organization. I mean, how--if you are a small business, how do you go out to Penn. and wander around the halls and find somebody who is doing some work that is of interest to you? We are trying to create an atmosphere where the business community of Philadelphia thinks of the universities as resources on a local level.

While this was going on, the Advanced Technology Center, under the Ben Franklin Program was being formed. They became sponsors and helped in the funding of the Resources for Progess program.

I assume some numbers were given to you yesterday. The State is giving $18 million. Our ATC in Southeastern Pennsylvania has received, for this coming year, $5 million which will provide, along with university and business contributions, a fund of $21 million to be used for the matching grant of the university work, to be used for human resources, for some training, et cetera.

Specifically, there are 87 projects being funded in the area of sensors, biotechnology, space adaptability for industry and human beings, and materials engineering and processing. The work has been going well. We have a number of panels which try to evaluate the proposals. We struggled with the question of how to select proposals. Ken Geller from Drexel, who is here now, has done a lot of work in trying to identify and develop criteria on how to select proposals that are meaningful and have a likelihood of output that will create jobs and help the economy of the Philadelphia area. As you can imagine, the State and the legislators are interested in creating jobs because that is what gets headlines and that is what gets votes. So while there has been somewhat of an unseeming haste in trying to come up with numbers on jobs to be created, in reality I think the program is going forward in an organized and long-range basis.

Our own Resources for Progress program is being integrated into this. We will have a program this fall in which we have introduced another player and that is the Philadelpehia Industrial Development Corporation, which in the past has been largely a group for funding brick and mortar projects with low interest rates. They have now decided, as a policy, that they will begin to provide

capital funds for high technology improvement to business. In Philadelphia, we are looking at the ways to use high technology for existing businesses every bit as much as we are trying to create new high tech business. This fall, we hope to be able to offer to businesses that have a need, money to improve their technology.

As to our own efforts, I got into this because I thought it was interesting, because I thought we could do some good for the community, but what has been very interesting is how much good it has done for our company. As I indicated, we are a relatively small company. We don't have a sophisticated R&D department, but we do have an engineering department capable of working with the University of Pennsylvania or Drexel to get ideas and to pursue them. After we got into this, we looked around and found that at the University of Pennsylvania there was work going on that had direct relevance to our sensor work for the iron and steel industry. We identified the specific technology that was going on, the researchers who were working on it and a particular researcher who we felt would be most useful for our work. He had come up with an invention, which we looked at and decided was of interest to us. After negotiations through Tony Merritt's office in the technology transer end of the University of Pennsylvania and University Patents, we arrived at a patent option that gave us the opportunity to evaluate and try to develop this technology. That is when the State Ben Franklin project came along. We were able to provide some Electro-Nite money, obtain some State money and create a program where we are doing some more evaluation of this particular technology. The results have been excellent and we are going ahead with a second year program, in which we hope to tie down the details of the technology.

We have wrestled with our needs as a small company for getting something done and Penn's mission as an educational institution, not a research corporation. We have addressed that and come to compromises that meet our needs. We have looked at the question of proprietary interests and we have decided that the publication requirements at Penn are compatible with our desire to keep everything secret, although we had to become more liberal. You just can't keep everything secret if you are going to work with a university researcher.

There have been some real benefits for us that I haven't heard mentioned here. I put these forward to you as possible sales elements in developing university relationships with companies. What have we gained? We have gained intellectual stimulation of a sort that we cannot provide for our own people in a small company. We have gained the knowledge that is available at the University of Pennsylvania and in the heads of the researchers who are keeping up with the field; who know what is going on in Australia; who know what is going on in Germany, etc. It has provided us with an insight into where our field is going on a world wide scope that we couldn't possibly do by ourselves. We have obtained consulting help on specific problems that we have been unable to solve ourselves, by getting some input from the group at Penn. We have obtained a scientific mentor for our own young people. We have some bright young guys, but we don't have a group of Ph.D's who can give the intellectual stimulation to this young group of engineers. The scientific staff at Penn has provided that and it's been tremendously useful to us. We have obtained what I think a university should be selling. We have obtained an on-going relationship. We do not look at this as something where when one product comes out of it, we are going to stop. We hope to be able to budget a significant amount of money for us to provide this relationship and to fund it from our standpoint and to see that over the years, the input that we get will be worthwhile. We have had to

discipline ourselves a little bit because every time we knock on a new door at Penn or Drexel, we find something that is going on that is interesting and we have had to narrow the scope of what we are doing to fit within our own budget. But I think it is the best way that a medium-size company can keep up with the competition that we are seeing, so that we can provide the new technology to the industry we serve and also have some fun.

I think out of this will come not only some new products, but some real advances for Electro-Nite. Looking at the broader picture, if we work with the Philadelphia business community and the state community, we are going to help the Philadelphia area retain the competitiveness that it must have.

Thank you.

MR. SINISGALLI: Thank you very much. After listening to you describe your activities, you can see why those of us in New Jersey are casting envious eyes over towards Pennsylvania.

Our next panelist is Graham Jones. He is the Executive Director of New York State's Science and Technology Foundation, which is an agency of the State government. He came to this position a year ago following a long, illustrious career at IBM, in which he held a variety of positions, in marketing, commercial product development and system development. I have asked him to describe the program called Centers for Advanced Technology, which is a university/industrial R&D program supported by New York State and administered by his agency.

Dr. Jones.

MR. JONES: Allen, I guess it is necessary for me to remind you that three of the four of us who are participating in your discussion this morning are here under duress. You will recall that we met at lunch yesterday and that we resolved that unless we found out what the other four surviving organizations were since the early 16th century, that we would be quite unwilling to enter into this discussion. I certainly haven't found out what these other four organizations are, and I think that the students have been held in suspense long enough.

MR. SINISGALLI: That's why I've insisted that the doors be locked while you're up there. I can't run the risk of you leaving prematurely.

MR. JONES: It's frequently somewhat confusing when the name of my organization is first presented. We are called the Science and Technology Foundation and that conjures up images of those worthy organizations which dispense the proceeds of large fortunes for philanthropic purposes. It is not my privilege to participate in an organization like that. Rather, we are an agency of New York's State government. We are a little different from a regular department. We are what is known as a public benefit corporation. We were put in place by legislation. We are a 501(c)3 type non-profit corporation. Our organization and our objectives were specified by the legislation which brought us into being. We get our funding from the general funds of New York State and our objectives when we were first formed back in the early 60s, were educational research; a kind of a little state NSF operation. Then in the late 70s, when the high tech thing came into vogue, some new legislation was put into place. Our current objectives are to promote high tech industries, other high tech activities and through those activities, to promote economic development, create jobs and enlarge the tax base of New York State.

When this was first put in place, in 1979-1980, the foundation decided to have an organization do a study on the overall opportunities in New York State and the resources of New York State. The Battelle people were brought on board to do that. The Battelle study of New York State and its opportunities for high tech development is now fairly broadly known. If anybody should want to see that, we have a number of copies of both the summary and the detailed study, which we are happy to give people. The summaries are free while there is a small charge for the entire study.

One of the programs which was recommended by that study was the program which I plan to say a few words about this morning. It is called the Center for Advanced Technology. This is our major program in industry/university cooperative development and research. Indeed, it is our major program overall. It far and away accounts for the largest portion of the funds that we use.

There are seven centers. Each center is located at a university and is a part of that university. A center, in the sense of this program, is a body of research and development work organized and run by that university, each being in a specific area of technology, or in a specific discipline or field selected by the State for its potential for economic development.

The funding for the centers, of course, is an important aspect of what they are. The funding comes both from the State and from industrial participants. The State provides the lesser of approximately a million dollars a year or 50 percent of the funding of the center. The balance is provided by industrial members. It is our hope that by bringing in industry, there will be cooperative work between industry and that university, and the industrial money will bring strong industrial opinions, which will result in the kind of applied research work that we have been talking about a lot in the last day and a half.

Let me emphasize again what our purpose is in bringing the people's money into this kind of an activity. It is not our purpose--however worthy--to enrich the research and educational functions for the universities. Clearly, the universities will not be interested in entering into these arrangements unless those functions are indeed enriched. But that is not the State's purpose. Clearly, also, it is not the State's purpose to enrich the industrial companies. They will each be looking to make sure that their objectives are being met in these arrangements. The objective of the people's money is to create jobs, and to bring about new commercial activity of one kind or another.

With each of these centers, we have a formal contract. Within that formal contract, we set up the objectives, the way in which the funds will flow, the principal people involved, the bare bones of the organization, and the manner in which the organization will be evaluated.

Let me just run through and tell you who the seven centers are. One of the characteristics of New York State, which distinguishes it from most others, is the very widespread nature of its academic institutions. They are all over the State and very different in character. We needed to have a reasonable coverage of the whole system. We do not have one, single monolithic state university system such as Michigan. The New York State University system is the largest in the nation by any measure, such as, number of students, number of campuses, funds, all these kinds of things. Our centers are at the State University at Buffalo in medical instrumentation and devices; University of Rochester, in

optics; University of Syracuse, in computer applications and software engineering; Cornell, in bioengineering of agricultural products and in animal and plant biotechnology; the agricultural aspect of biotechnology as distinct from the medical or human aspect; Columbia, in computer hardware and information systems; Polytechnic Institute of New York in telecommunications; and the State University at Stony Brook in biotechnology in medicine. You will be hearing more about that from Dr. Cook.

I should, as I run through those seven centers, mention the Center at Rensselaer Polytechnic Institute. This is a center which is in every aspect analogous to the centers which are being funded by the State and was created at the same time. Indeed, the center at RPI, known as the Center for Industrial Innovations, was the beginning of all this activity in New York. It was the great mind and spirit of the late George Lowe that got that whole activity moving. He put his Center in place and he asked the State to help with the buildings and got it. At the same time as that legislation went in place, the seven centers that I am speaking of were put in place.

Our foundation does not handle real property and capital construction at all. We are not in the building business. It is the operating funds that flow through us. There is a difference between the way the RPI Center is set up from our other seven centers, but the function is very similar.

How were these centers chosen? This was quite a careful process. Let me say a couple of things about it. We put out a solicitation, a request for proposals to each of the 36 research universities and a 140 odd other institutions; the latter 140 more for information in case they wanted to join in consortia responses. But the principal people that we solicited were the 36 major universities in the state. Of these 36, 19 responded to us and of the 19, of course, we made seven awards. In order to evaluate the responses we got to our RFP, we asked the National Academy of Science to set up panels. For some of these panels, we had to ask them to listen to us very carefully as to the kind of objectives that we had in mind, because our whole objective was different from what most of the peer review panels are used to evaluating. We were not simply interested in the academic excellence of the department under consideration or the world prominence of the work being undertaken. We were as much interested in their potential for doing strongly applied work and for the ideas from that work which might flow through into the commercial sector. The National Academy was precise in following our instructions in that respect. They made the recommendation to us and with some very minor twists in order to accommodate a couple peculiarities, we followed precisely their recommendations.

Each of the centers is organized somewhat differently. Each has proposed how it is going to do its job and each one has chosen to do it slightly differently. Broadly, they fall into two categories. In one category, the commercial members of these organizations provide their funds into a general pool, then proposals are solicited for research work, and the selection of research work is undertaken by the university and the industrial people in cooperation. That very process is an extraordinarily interesting process for many of these people to go through, from a sheer educational point of view among other things. It is a surprise to each party to hear the criteria that the other party uses in selecting the kind of things on which they want to work. It is an educationl eye-opener that is a positive influence on the whole technology transfer process.

In the other category major corporations contract with the centers for specific directed research and the State money is available to do projects which either are not connected with any specific company or are of interest to smaller or brand new companies who cannot afford to get involved in buying university research. This is how we get the small companies involved as well as the big ones, which is not always easy.

Brochures providing further detail on the centers can be obtained by giving me your name and address.

I wanted to say a couple of words about what I think are the strengths and weaknesses of this kind of vehicle for technology transfer. You have heard some things about the Ben Franklin partnership, which is an extraordinarily successful undertaking in our sister state. I think the key difference between what they are doing and what we are doing in this respect is that their coverage of their educational institutions and of all the activities involved in the formation of new companies and of new commercial activity is much broader than ours. Our particular program is dedicated specifically to the research activity which we believe is going to bubble up new technologies, new products, and the kind of people who are going to bring them to market. By funding a body of work, rather than simply project by project activities, the university is able to plan and focus its efforts to really build a center of excellence in applied research that would be hard to do in any other way. I think there is a key educational advantage in this kind of a setup. It applies just as much to any university undertaking and it has been mentioned before, but let me re-emphasize it because I am particularly sensitive to it. A significant part of my career was spent in the development labs representing the sales department, trying to make sure that the engineers built what was a useful product or process for some customer and not simply a monument to their technological ability. Very often, you approach an engineer and he will say one of two things to you. Either he will say tell me what to build and I will build it because many engineers get their jollies by putting something together that works. It is like building the old train track and getting that train running around for the first time. I don't mean to be sarcastic with this, as all of you know who have done that. There is a tremendous satisfaction in doing that, especially in something really complex, and new. The other thing that the engineers may tell you, other than tell me what to build and I will build it, is look at this thing that I designed and built and whatever it is that you want done, this will do it.

Now, there is a lack of cooperative back and forth interaction in either of those relationships. You really need the iterative process, where the needs and the capabilities are being iterated back and forth until you really find the best product. That is exactly the kind of thing that engineers have a chance to learn if they are exposed to industrial projects at the same time as they are going through class and learning how to optimize a design. If they go out into the world convinced that the design has to be optimized and don't appreciate the give and take of real world design it is going to take a bunch of people like me to try and turn them around and we will never succeed. I have heard a number of engineering deans who have recently become involved in industry cooperation with universities and I am finding that this aspect of education is being brought out.

Naturally, in all the more applied areas of research, this kind of relationship brings about relevance. I am sure many of you must have walked through engineering research departments, medical research departments, or whatever and you say to each researcher as you go by, after asking him about the wonderment of the particular thing that he is doing, how did you get started on that? Why

are you doing that? Why was it important? Well, it seems like the interesting thing to do. Oh, I couldn't find anything in the literature on it and I was interested in it. A lot of somewhat disconnected responses are heard. My word, if you get some industrial people in there, they will have a hundred things that need to be investigated and with very good reason, because at the end of the line, there will be a real use for the outcome of those investigations. So I think there is a whole area of direction and relevance of research that comes from this kind of a relationship. It comes from companies both large and small.

Now, it is terribly important that if technology transfer is to be successful, we must get both large and small companies involved. That isn't easy in the kind of structure that I have described to you. The large companies are there and they bring their money and their opinions, but we have got to work on bringing in the small companies. We have got to make sure that that happens and, of course, we have got to work on it to make sure that there are opportunities for the new companies to bubble up.

One of the things that's interested me is that as we look at what the large companies bring, I expected them to have a real whip hold on these programs. It isn't so for a couple of reasons. When a large company gives funding to a university research department, it often does that in a somewhat philanthropic way. It wants to get a hook into some of the better students for later on and it wants to keep an ear to the ground and a good relationship with those smart birds over there at Old Sorry Wash Tech. But as far as saying here is what I want you to work on, it doesn't always happen. Indeed, I found that sometimes the corporations will assign personnel to the university who enjoy working with university types and send them to Buffalo or Cornell or wherever. In such cases, I do not see as much influence as I expected.

The general things that I have to watch out for is that this money doesn't flow into the general research. At the big research university, the big ocean-liner, it's pretty hard to change it through more than a point or two on a compass.

I would like to make a couple of nice remarks about the role of the State in all this activity. I guess it is worth noting tht I am the first State bureaucrat on your program and I believe I may be the last. Very clearly, industry/university cooperation does not need State government. It is happening just fine without us. The thing that we are trying to bring to the table is the economic development arm of the thing. It is unreasonable to expect that either universities or industries should pay for that kind of activity out of their coffers. I do not think it should be coming out of student fees; I don't think it should be coming out of your endowment; and I don't think it should be coming from charitable contributions from the companies. Economic development activity should be under the tax base. I think that the State has a proper role to encourage this kind of activity; to nurture it; to make sure there is more of it; provided that we believe, with good cause, that there is going to be economic development resulting.

There is, of course, the competition between the states in this respect. You have got to do some of this just to keep up today. Every state's doing it. Indeed, there's a lot of deans of schools where we have our centers, that regale me with these little newspaper clippings. New Jersey just floated a $90 million bond, you know. Texas just funded 32 shares at a million bucks. What are you doing, Jones? I hear a lot of that. Your colleagues use that to good advantage.

I hear a lot of speeches about that. They usually follow with some slightly uncomplimentary remarks about the current administration and that research is falling apart, our equipment is falling apart, our buildings are outdated, and state government and industry have got to help. I think the sheer size of the problem belies that point of view.

Of the seven and a half billion bucks that you see going into research around the country, almost a billion comes to the universities in New York State. I do not want to see my State taxes burdened with a significant portion of that bill. I do not think that a significant portion of the operating expenses, the equipment or the buildings is going to come out of State coffers for that research. I think that must continue to come out of the federal government. Indeed, it is my belief that anything that affects the overall level of research, has to depend on the federal government. For anything that benefits your corporation or vice president, the feds shouldn't be involved. Now, of course, this is not at all a clear cut criteria, but it is at least something for us to bear in mind. It should be the applied activity and it should be the part that bears on economic development. I see this kind of role for the State government, and I see it continuing, but limited. Also, I see industrial funding as a continuing thing in our society, but again, limited. God knows, we don't want it to be more than five or ten percent of the funding to the universities. We don't want that kind of influence. We want the universities to be doing the basic research and then a small amount of money to keep communication going with industry. That's my view.

Again, if anybody wants further descriptions of our centers program, it would be a privilege to provide it. Thank you.

MR. SINISGALLI: Thank you Dr. Jones.

We are very fortunate this morning to have with us Dr. Richard Koehn, who is the Director of the Center for Biotechnology, at the State University in New York at Stony Brook; one of the centers described by Dr. Jones. I suggested that he discuss the strengths and weaknesses of this model from his perspective. I guaranteed him he will not have to arm wrestle or fence with Dr. Jones and that I will stand in the middle while they harmoniously tell you about their program.

MR. KOEHN: Thank you, Allen. Well, I think that my function, as Allen has said, is to give another perspective to the Centers for Advanced Technology Program that Graham Jones has just described.

I would like to begin by actually disagreeing with one of the speakers yesterday, Dr. Langenberg, whose talk I enjoyed very much. I don't believe that universities are stable entities. They are stable generically, or structually, but the missions and the characteristics of universities have changed, are changing and will continue to change. In some cases, these changes are rather drastic as witnessed by the upheaval of Chinese universities during the cultural revolution; an upheaval that they are now trying to recover from. Sometimes they are not so drastic, fortunately, as represented by the formation of land grant colleges and the inception of research universities. The influx of research dollars into colleges to transform them into what we now recognize as research universities for example, can be viewed as a rather drastic, constructive, directed and controlled change from the classical characteristics and missions of universities. These changes expanded the realm of teaching institutions into what we now recognize as research universities.

I think that one of the major points of this conference is: How do we facilitate a change, ever so slight perhaps, but a change nevertheless, to reconfigure universities so that they can effectively and productively interact with the private/individual sector?

What I want to talk about this morning is what I see as the essential elements, at the local level, of this reconfiguration in order to facilitate this university/industry partnership. I am going to use as an example, the Center for Biotechnology at Stony Brook, which is, as Graham has said, one of the Centers for Advanced Technology of the State of New York. I will describe a little bit about the Center and how it functions; how I see the essential elements that were described very well yesterday by, I think, Mr. Hill, how those essential elements can be put in place, what I see as the successes so far of the centers and some of the failures, and to point out at least what I think to be the important characteristics to those of you who are contemplating similar reconfigurations in order to perhaps bring yourselves into a better orientation to collaborate effectively and actively with industry.

I suppose some of you may not have heard of Stony Brook, though I doubt it. Despite what Harold said, there are such things as instant universities and Stony Brook, in fact, is one. Twenty-five years ago, it was a series of holes in the ground and today it is a major research university which has about $40-$45 million per year in research dollars coming to it. The research budget increased about 20 percent last year, so it is an active research center; in fact, the most heavily funded research center in the SUNY system and the one that is growing most rapidly. This level of activity reflects the strength, largely in the biomedical area of medicine and the life sciences. A very large and dynamic research community exists in these areas. About five percent of the research coming to Stony Brook is coming directly from the private, not including unrestricted grants or gifts. The totality of the corporate dollars coming through the Center are targeted specifically to individual research projects, those with a specific product in mind. This is a characteristic which I want to emphasize and which I think you should bear in mind as I describe how the Center operates. It is not like, as Graham described the one center, a situation where there are large corporate dollars coming into a common pool which is then divided in response to proposals submitted jointly by industrial and university personnel. Rather, our corporate research contracts, by and large, are targeted directly to specific faculty or specific research programs with a specific product and time-line in mind. It is, I think a good design; one which maximizes productivity and the return on corporate investment.

The Biotechnology Center is really just a broker in this process. It is an organization which preceded the CAT designation that Graham described but, of course, received a tremendous boost from that designation. It is governed by a board of directors which consists of eight people. There are four university representatives who either have had experience in industry or are actively involved in collaborative research with industry, so they know what this partnership is and what it should be. The other four individuals consist of a Vice President for Development of a large, very well known U.S. pharmaceutical company; another Vice President for Research of a large biochemical and genetic engineering company; the President of a small genetic engineering company, a company that's concerned primarily with production of monoclonal antibodies and a venture capitalist, whose interest is in developments primarily in the life sciences and biotechnology. The policies and direction of the Center are governed by this group of people, in consultation with the university administration.

I said that I would talk about what I see as some of the essential elements in this enterprise at the local level. The first is, I think, a mechanism for establishing contact between the university and specific corporations in the private sector. This is, in fact, a very difficult problem and one which varies in magnitude depending upon the size of the industry or company that we are talking about. It is a particularly difficult problem for small companies. First of all, small companies, as I probably don't need to tell this audience, have the greatest need for assistance of nearly every kind. They don't have their own research and development division. They don't, in fact, even have very much money to put into research and development. So they need financial assistance. They don't have the time to decipher the bureaucratic structure of a large research university. As Max mentioned, a small businessman simply is too busy trying to keep the doors open and keep food on the table to wander around the campus knocking on doors, trying to discover if, in fact, there is someone there who can help with a problem that they may have. They don't have any knowledge of the legal complexities that can arise from the involvement, in this case, with a state agency. It is different in a private institution;there will be nevertheless, agreements that must be struck and bargains which must be made, but in a state university, these are particularly serious potential pitfalls to a small business.

It is important to be conspicuous to the local business community to work with small businesses, with small business associations and regional development groups. I give a lot of talks or presentations of this type to small business organizations in order to make them aware of the, really, quite overwhelming, intellectual and facility resourses that exist at Stony Brook and to emphasize that there are opportunities to take advantage of these resources.

Second, it is important that the private sector be knowledgeable about the details of the university. Obviously, one can't respond to contacts from local businesses or local startup companies about their needs if you don't have knowledge of the tremendous diversity that exists on a large research campus. This is a real problem. One has to have inventories of the specific research expertise, and the research interests of the faculty. In the case of Stony Brook and other large research universities, these range in the hundreds of faculty. It's a rather large job. We try to keep aware of what's going on in various parts of the campus so that we're in a position to respond to inquiries for assistance or inquiries on particular research problems, whether it be for the large or a small industry.

Third, I think it's important to be cooperative. It's sometimes difficult to determine in discussions with small businessmen, exactly what it is that they have in mind. It's sometimes hard to decipher, I suppose, because I have no industrial experience. So it's important, I think, to be cooperative and to move these people around the campus into different offices, depending upon the initial need so that one makes an honest effort to be helpful. It's important to try to understand the needs of these companies so that they can capitalize on the resources of the campus.

For large companies, it's been my experience that this is a very different problem. In fact, it isn't so much of a problem at all. The range of our contractual experience is from the very large pharmaceuticals, like Eli Lilly or Merck, Sharp & Doane, to very small, sort of a "mom and pop" operation, it spans the spectrum. In my experience in dealing with large companies, contacts do not occur through my office primarily. I can tell you a story of one that did and

which did not turn out successful. I am not certain exactly why, but I think I know why. I was approached by the Vice President, actually three Vice Presidents of a major American corporation that is not known for its biomedical research, but, in fact, spends about $500 million a year on research in the biomedical field. They visited the campus and we discussed what we had to offer and what their interests were. It became obvious that it was going to be very difficult to identify specific areas where we might serve the industrial needs of this company. The reason we couldn't identify these specific needs was because these people, while they could speak for the general directions of the company in a broad brush-stroke way and had a feeling for research activity in the company, could not address the bench level needs of their technological problems. Successful interaction with large industries has been consummated in appropriate contracts through these bench level contacts. It has been my experience that the contacts from large corporations, those which have their own research and development division really come at the level of the individual scientists. These departments in companies, of course, are not unlike departments in universities. They are scientific communities. People are reading literature, they're doing research, they're going to meetings and are plugged into the community of scholars. They know who the people are that work in areas that are germane to particular problems with which they are concerned. They know there's a person at Stony Brook or Cornell or Stanford who works on a particular technique, say, for producing a particular antibiotic or whatever. They don't need to discover the resources of a large research university. In my experience the partnerships that we have established with large corporations have really come from the bottom up. They have come from contacts between people working at the bench. They talk about common problems and eventually they are thinking in the form of what they can do together. What we have to do is really make this participation a little more formal and then it comes through my office and we begin talking about a specific research contract.

Another important characteristic, is that universities and centers such as ours permit and facilitate (in fact, even encourage) communication between university and industrial scientists. As I have already mentioned, research groups, whether they are at universities or industries, have a lot in common in the biomedical industry, particularly in the biotechnology/genetic engineering areas of the biomedical industry. It is a growing fact that some of the more distinguished, innovative, and creative individuals in industry, are those who have moved recently from universities. I think it is important to facilitate contact and communication between those scientists.

We have an industrial affiliates program, similar to some of those that were discussed or described yesterday, particularly in molecular biology or molecular genetics. It is a program with about 30 corporate members. As members of the affiliate group they receive a number of very specific services ranging from invitations to seminars, copies of publications, access to faculty, and an annual symposium in molecular biology, which they attend and, in fact, have some impact in organizing. These have been on such topics as the "Molecular Control and Gene Expression in Gene Therapy". They get a fairly reasonable quid pro quo for the $3,000.00 membership fee, which is in my mind, very cheap.

One of the major points I wanted to make was that we have scientists from these companies come on the campus for a variety of different training experiences; sometimes just for a few days. But we also will have had scientists for a year or two. The individual industrial scientist is able to learn the cutting edge technology of a particular specialty in the life sciences. Similarly, last year

I had a faculty member do a sabbatical at a major genetic engineering company on the west coast. He went there, of course, because it was a highly attractive, intellectually and creative enterprise in the area of his own research specialty. Unfortunately, the company hired him--offered him a job at twice his salary. I think there is a lesson in that. This is going to continue to happen, especially in biotechnology, and I think there is only two things that are going to stop it. One is to make university salaries competitive. Since that's not going to happen, the second is for the university to create policies for cooperation where people can, in fact, move back and forth. University scientists see these moves very much as a bridge-burning operation and I don't think that's the right attitude and I don't think it's productive for either industry or the university.

Another important component is, of course, incentives to companies. There will have to be intelligent patent policies and certainly a willingness for discussion of contractural agreements that permits both industries and universities to benefit from this partnership. I think the question was asked yesterday as "who should benefit?" I think the obvious answer is, both should benefit. In our particular case, corporations are putting money up front for a particular product and they should accrue the benefit of that product, but they are not just buying brain power or knowledge from an individual. If they were, they should hire that person as a consultant. They are actually buying into facilities which were created, by and large, by the taxpayers from the State of New York. Those taxpayers should benefit from the development and use of those facilities as well.

Another incentive, of course, is provided by the CAT program of the State of New York, which Graham has already described. There is approximately a million dollars every year available to the Biotechnology Center for enhancing this interaction or this partnership between Stony Brook and industry in biotechnology. The way that this usually works is that we make matches to corporate contracts, usually on the order of about 20 percent of the value of the contract. We are prepared to make higher matches, but those must be requested and justified in the context of the purpose of the CAT program.

Lastly, I think it is important that universities make some effort to provide facilities and space for small startup companies. In the case of private institutions, it is a little easier, because they can govern the use of their space. However, for a state agency, of course, this is, not permitted by New York law. In New York, at least, I could have rented or leased about ten thousand square foot of laboratory space in the last two months, had I had it for small companies who wish to locate in our area. These companies are developing products in areas that they feel our faculty could provide important input. I do not have any such space. We are currently having discussions with the Urban Development Corporation, UDC, which I suppose, is better known to you for developing hotels on 42nd Street, but nevertheless, is getting involved in incubator facilities in high technology. We are hoping to have some space adjacent to the campus soon.

That's in general how the Center works. I think I will conclude with one specific example that we are presently involved in with a small company. It is called Protein Database Inc. This is a company that is offering a service based upon a technology that spun out of Cold Spring Harbor, which is a large, old and very distinguished, genetics laboratory. They offer services for 2D-gel electrophoresis, which is basically just a technique for separating cell constituents. While this is a fairly common technology in biomedical sciences, this company is

offering a really highly sophisticated software for the analysis of the spots that exist on these gels. It is an important technology for diagnostic problems, for example. One of the things that they need to identify is what might be the specific nature of the various protein constituents in these various cells. They have come to two of our neuroscience faculty for assistance in elucidating the nature of the major protein constituents in neuron cell lines. They have a new research laboratory and they are going to open the doors for business this fall. They needed to increase the protein data base they have, particularly in neural areas. They are putting up the equivalent of about $300,000 of in kind services, the kind of services that they are actually selling or will be selling commercially, for analysis of cells that we are going to grow. Also, they are providing a computer terminal in our laboratories with access to their data. They are located about 20 miles from the campus and this facility will be important, not only to the individual who is involved in the contract with the company, but really to a large number of our faculty who will have access to their data. We are putting up, through the auspices of the CAT program, about $80,000 for funding some of the bench work that will have to go into this particular project. So in total, the project is going to run somewhere in the $400,000 to $500,000 range for a startup company, and they are getting a lot more for their money by participating through the Center. That is the kind of incentive that we have to offer.

Well, I will conclude by saying that I think that the changes that have occurred at Stony Brook through the Center, represent the kind of small reconfigurations of universities that can enhance partnerships with industry. I should say that they don't merely enhance the research enterprise in the industry, but in fact, spin back into the educational program of universities. I have seen a really trememdous increase in the activity between Stony Brook and the private sector as a consequence of this program. Thank you very much.

MR. SINISGALLI: Thank you very much, Richard.

As I predicted in the beginning, the presentations were extraordinarily interesting so I let things go a little longer than I should because I was truly interested in all that was being said. Please forgive me, I have impinged into your coffee break a little bit and we will have to take fewer questions than normal.

Dr. Hall, several people have asked about the programs at Xerox. Do you foresee that targeting your programs at certain institutions and in certain fields is a healthy policy for the company?

MR. HALL: This targeting is a new phenomenon in the company, and it is one which the company management believes is appropriate to the new challenge. There is a great deal of variation in the style of the targeting. SRC, of course, is a very large cooperative activity involving many participants. Our venture with Stanford University in the Center for Study of Language and Information is a very small group, but again, it very specifically targeted in a very long-range aspect of artificial intelligence. Xerox does those things where it sees that more return for the investment will come from a cooperative targeted enterprise than from a self-contained Xerox research enterprise or indeed, from just general traditional industrial philanthrophy where one makes undesignated grants for general institutional purposes.

MR. SINISGALLI: Thank you very much. The next question is directed both to Max Karus and Graham Jones. With state and local involvement in the research enterprise and the particular lure to create jobs and to maintain existing corporations within the state, questions emerge on how do you measure your success. Have you anything that's tangible in the way of numbers that you report to the legislature to justify the appropriations to which you referred? Exactly what return is the State getting for their investment?

MR. KRAUS: In the case of the State of Pennsylvania, yes, there is a rather elaborate reporting procedure involving quarterly reports from the Advanced Technology Center to the State and then an annual report. Each of the participants is asked to report on the number of jobs that have been created in industry by the work that's going on. It's obviously, in my eyes, premature to ask at the end of three months how many jobs have been created by a research project when you still don't know if it's going to work. But I think the Advanced Technology Center people have successfully circumvented these questions and are making reports. I do not have copies of the reports. I would be glad to arrange with Phil Singerman, who heads the ATC of Southeastern Pennsylvania, to get those to anyone who is specifically interested. By the way, I have some copies of the brochures, announcements, and other things that we have put out in Philadelphia and I would be happy to share those with you or to provide additional copies.

If I may take an additional minute, we have also put out a Technology Counsel News in the City of Philadelphia, by which we are trying to interest local businessmen in what is going on and I have copies of those here.

One other comment. We have a part of our company in Belgium and we find that the same thing is going on there. We are getting considerable national aid over there and they have a requirement that the commercialization and production of products developed in Belgium, must be done in Belgium for a certain period of time. The State of Pennsylvania has a similar requirement in the Ben Franklin program in that you are constrained to do a substantial amount of the production in the State of Pennsylvania. There are some guidelines on that. I think it is important to note there are strings being attached to these things. I do not see them as unreasonable strings, but it shows that the individual states and this country are developing policy to try to keep jobs within an area or within the country.

MR. JONES: I think the evaluation thing is very difficult in this kind of program. We do see some specific initial success stories. The existence of centers has pulled in some good people, has pulled in some departments of companies from other states. I clearly see some projects which are going to have a beneficial effect on commercial activities.

I should point out that Stony Brook along with three other of our centers are the oldest four and they are just a year old this week. So it is pretty early to be able to count the jobs. That's always going to be difficult, particularly because there is no control experiment. The thing that we have to do this year and we are committed to is an evaluation, which, of course, will be based on identifiable commercial activity coming out of the Center. The evaluation will include examining the projects that have been selected as to both their innovativeness and their transferability to the commercial sector; the overall flavor of the center; whether it has a well articulated objective and an

organization that altogether knows what it is doing demonstratively; and a variety of other criteria of this kind that can be used to try to measure the potential for creating commercial activity. Naturally, the industrial companies will have their own evaluation of the program.

MR. SINISGALLI: Richard, this is the last question I picked out of the pile because it is a favorite of mine. Still I am going to repeat it as written without any elaboration on my part to color it. "How does your center get faculty to cooperate in helping small businesses? Through consulting fees or as volunteers? Do many faculty refuse because their time is already committed?"

MR. KOEHN: Well, the answer to that has about as many answers as there are faculty. By and large, the faculty, I have found, are very cooperative and I think particularly those faculty who have had experience or previous contact with industries. They recognize their problems and even though they are busy, as all faculty are, they do make time to be helpful. We don't provide any specific monetary rewards for our faculty to participate in this program and that's really because of the nature of the program. We are not asking favors from the faculty. What we are experiencing, is an in-reaching by companies to our faculty because of their intellectual resources and the mutualization of those resources in the form of corporate contracts. Now, what the faculty member gets for that, of course, is a source of research money for development of a particular end product, a drug or drug testing, or whatever, but there is a lot of things, as you know, that spin off from these kind of activities that are cogent and important to the basic research. They get benefits from this typical to any source of research funding.

MR. SINISGALLI: Thank you. Well, I thank the panel very much and I thank you all for your time and good morning.

SESSION VI

THE INVESTMENT COMMUNITY AS CATALYST

MR. DUMMER: For many of us, the role of the investment community has seemed remote from the university research programs with which many of us normally deal, and interaction with that community has appeared to be limited primarily to those who have the responsibility for the investment activities of our institutions. But the investment community has in the last few years become highly visible, in some cases dramatically so, in the formation of a broad variety of new ventures and arrangements, some embracing the private commercial interests of faculty entrepreneurs, and others directly involving the universities themselves.

Session 6 deals with how the investment community operates, the various financial arrangements it uses to fund R&D and company startups, and its view of the research university as a source of commercially viable technology. This session takes a fairly broad view and sets the stage for the more specific treatment of the research and development limited partnership and venture capital mechanisms, which will be dealt with in the case studies to be presented in Sessions 7 and 8.

It is my pleasure to introduce as your moderator, Tony Merritt, Director of Research Administration at the University of Pennsylvania. If you will look in your program, you will notice that Tony is also the President of Governmental Relations, University of Virginia. This is a new assignment for Tony which was given him by an errant word processor.

MR. MERRITT: Thank you, George. Dennis Barnes, who is the Associate Vice President for Government Relations at UVA, remarked upon seeing my title in the program that he wasn't surprised at that since he didn't think I did anything at Penn anyway. That was a misprint.

Welcome to Session 6. As George has said, we are going to be discussing the investment community as a catalyst. As he has indicated, this involvement by universities with the investment community is really somewhat revolutionary.

In the earlier sessions we have been discussing a number of the more or less traditional interactions between universities and the private sector; activities which, to a greater or lesser degree, have been ongoing at many institutions for a number of years.

In this session and the two immediately following, we will be presenting some new, if not revolutionary, approaches to supporting R&D at universities and transferring the resulting technology to the commercial sector. Among these are the use of venture capital, R&D limited partnerships and the startup of new companies based on university developed technology. As universities begin to explore these non-traditional sources of support, they will come in contact with a very different culture than has been encountered previously. Mention has been made earlier of cultural barriers to university/industry interactions and ways to overcome them. This is no less true when dealing with the investment community. If we are to be successful in tapping this potential source of resources, we must learn to avoid the barriers and at the same time, educate that community about our culture.

You will note on the program that there were originally four panelists. Unfortunately, Lon Harriman, due to an illness in his family, will not be able to join us. So we will only have three panelists speaking to us.

The initial presentation will be made by Patricia Cloherty, President of Tessler & Cloherty, Inc., an investment banking partnership in New York City. Pat has an interesting background. In addition to being involved in the investment community for a number of years, for a period of time, she was the Deputy Administrator of the Small Business Administration. At one time, she was President and Chief Executive Officer and then Chairman of a publicly held New Jersey based distributor of early learning material and equipment. She spent a period of time in the Peace Corps in Brazil involved in agricultural extension programs. Her educational background includes a Bachelors Degree in Spanish literature from San Francisco College for Women, a Masters Degree from Columbia in comparative education, and a Masters Degree in International Affairs.

Pat is going to talk to us about venture capital and what it can and cannot do for university R&D and technology transfer.

MS. CLOHERTY: Thank you, Tony. Salmon farming has been discussed by an investor as a classic venture capital experience, as follows, "We spent two cents apiece to produce, fertilize and culture 20 million salmon eggs. Second, we hatched, housed and fed 10 million little fry at a cost of 10 cents each. Third, for another 30 cents we released 5 million fingerlings into the river and watched them swim out to sea. Then we began our three year wait to see whether a million of them would remember to swim back to our nets with $3.00 apiece in their bellies for us."

I have been asked to comment on the subject of venture capital as a catalyst for bringing university based technologies into the commercial light of day. In discussing the subject, I should say I feel a little as if I have come home.

I have been in two venture partnerships over 14 years. My first venture deal done in 1970, involed backing a spinout from two prominent universities, one in a large western state and one in a small New England state, involving mathematicians, and electronics engineers. It was my first deal. In those days, the dollars involved were fewer than today. Within a year, they had researched some absolutely fascinating questions: regretably, there still was no product. The end of the story really was quite a happy one. We disbanded the company and the principals went back to the university. They completed the work and, like the Phoenix, arose from the ashes, with a marketable technology. The company sold for a capital gain in 1976 to a major independent telephone company. So I started my career, strangely enough, with my feet in the university environment and learned a lesson about basic research as distinguished from product development.

I am supposed to give the background on the venture business, which I am delighted to do. First, I will touch on what is venture capital. For those of you who already know, it may be repetitious. For those who don't, I hope it is informative to your understanding of the basic premises of the business. Second, I will touch on what you have to do to get it. Third, I will comment very briefly on how I see a decline just in opportunities in the university environment. And fourth, I will mention a few of the problems that arise in backing ventures sponsored by the academic community.

My personal view is that when applied appropriately, the skills found in the venture community, as well as the capital, can provide ideal transitional vehicles for moving particular technologies from the lab to commercialization. But the venture tool is limited by its nature, as are universities. By explaining a bit of how the business works; its goals and the techniques it uses, perhaps I can clarify for you the narrow zone where, I think, a mutuality of interest exists. I ask you to hang on to your hats a bit. Venture capital is, as Tony said, another culture and another world. I will describe the venture business.

Venture capital has come to be known as an industry in its own right, and it is institutional in nature. It is only one part of broad and highly variegated capital markets available to finance ventures. Another segment relevant to early stage ventures is what I call the "family and friends" portion of the capital market. In this, individuals (not institutions) who know you, or have known you for years and trust you, put some money behind you. Their return requirements tend to be somewhat less rigorous than those of institutions. The seed capital premise is that if your mother won't back you at that stage, who should?

I will focus not on family and friends, but in that portion of the venture capital market that is principally institutional and technologically-oriented. Our missing speaker was to have discussed the public securities market, yet another dimension of the capital market available to early stage companies having certain characteristics. This will not be covered in my discussion.

Basically, a venture capital fund is a financial intermediary managing other people's money for a higher than average return. The primary means the venture business uses to secure that higher than average return is through a program of investing in equity or equity like securities in early stage companies that show promise for rapid capital expansion. The target rate of return of each venture varies, and it varies overall from portfolio to portfolio. It varies also with yields available from alternative investments at a given time. The business is competitive, then, from a return standpoint.

We use a rule of thumb, that a venture portfolio should return, before taxes, three to six times the real return available from the most secure and liquid instruments available in the money market; this over a three to five year holding period. (The time horizons of venture funds for holding investments also differ. They range generally three to seven, the average being five.) For example, if U.S. Government debt securities maturing in three to five years, offer 11 to 12 percent annual yield or seven to eight percent real return, before tax but after inflation, then a venture portfolio should produce for its investors three to six times that to justify the risk expense and work involved in undertaking the activity. Otherwise one just buys treasury bills and relaxes, with no risk, complete liquidity and current income.

To be a financeable, then, a venture, should promise credibly a minimum pre-tax return of 35 percent compounded annually, realizable within a three to five year holding period. What that means in terms of multiples on capital is that the investor would look for two and a half times his or her money in three years and four and a half times original capital in five years. These are multiples on the original capital invested, and assumes no interim dividend, or interest are paid. As pointed out in the session yesterday, by others, the time value of money does count.

Return, in the venture business, means the cash actually received by an investor on sale of an investment to others in the required time frame. The resale is normally at capitalized values, that is multiples of assets and earnings, which reflect future expectations for growth of earnings and net cash generation. The ability to value in this fashion, i.e. at multiples of earnings, make very high return expectations possible. (It is only in the United States, that this is the case.)

Minimum target returns for individual investments tend to be higher than for portfolios as a whole. An investor may look for 60 percent, 70 percent return from individual companies, to allow for the losses which you are sure to get and for the expenses incurred in the process. The return requirements are at the heart of the venture business. At least that is the measurement of success if one plans to be in the business and to stay in it. Investors by and large, do not invest for "windows on technology". They are in it because it returns more than something else they might do.

As a historical note, I would mention that the theory of the business is that people with substantial wealth can afford to put small amounts of their total assets to work at very high risk in anticipation of extremely high returns, leaving the bulk of their portfolio to be invested very conservatively at little or no risk. This is as true now as through the years. World-wide, the bulk of venture financing has come from wealthy families controlling large corporate resources. It is really only since the mid-1970s that the venture business has become institutionalized with pension funds, university endowments, insurance companies, commercial banks and the like putting large dollars into funds resulting in much more formal fiduciary standards for rate of return. This entry of institutions into venturing results from high inflation and was facilitated by changes in the pension fund regulations. The latter enabled pension funds to put small amounts of capital--what is small to them, large in the venture business--to work at higher risk for substantial returns.

The operating policies of venture funds, and practices, are all geared to securing the kind of return I have mentioned. Creating new wealth rapidly is not an easy task. Several policies guide venture people. They have criteria for selecting investments; they control and stage the amounts they put in any single transaction. In structuring a venture, you need to know how the transactions are valued, what instruments are used, that is, equity versus debt instruments, and so on. What very important to many people in the academic world, are the kinds of control mechanisms that attend such a transaction and the negotiation thereof. These can include seats on the board; control over changes in salary and salary levels; control on incurring debts, hypothecating assets, reporting requirements, both financial and technical, and so on.

The types of deals venture people look for are dictated, again, by the return requirement. A couple of basic principles in the venture business today have become confused. First, is the fact that there is no fundamental link in the business to technology projects. Investors look for return, which can be found in technology and elsewhere. In today's environment, for example, there is a historic opportunity in the much less competitive area of financial reorganizations; fundamentally good companies that have troubled financial structures. Returns can equal or exceed those available in technologically-based transactions, without the down side risk. Technology-based deals compete, to some extent, with leverage buyouts and with nontechnologically-based companies looking for venture

capital. Looking at another country illustrates risk trade-offs between technology and other risks. In a rapidly-growing country such as Brazil, one need not take a technology risk. You could make similar returns, for example, by integrating horizontally the automotive aftermarket. This requires no new experimentation in the technology of spark plugs, fan belts, etc. But there is a managerial risk and an overriding political risk.

The kind of transactions on the radarscopes in most venture companies, are not very early stage R&D seed projects. Most funds seek fairly advanced applications of technologies which are emerging from the lab and into commerce; which are patentable or otherwise protectable; which involve seasoned managers with a business plan; and are destined for substantial markets. The investment can be staged pursuant to performance bench marks. Divestment markets must exist or appear to exist in the targeted time frame.

The planning is important, though in many seed projects it probably is not possible. The plan should define the product, its proprietary characteristics, the markets, the competition, the trends of the market, the regulatory features, and any extensions of the core technology. This should be summarized in three to five year profit and loss projections, balance sheet projections and cash-flow projections, together with descriptions of the people who will turn the plan on and make it work. The emphasis is clearly on "getting the job done" and creating long-term values. With this all done, investors and managers have to worry about whether the technology works; whether it can be applied successfully to the commercial product you propose; whether it can be manufactured economically; and whether the market will buy it at the price you propose. If everything goes well with product development, the next question is will the market be large, uncrowded and profitable enough, long enough to permit the investment values to be realized. This last question is a critical one. Successful technology based ventures may earn unusually high gross profit margins. These profits, however, must recover early development costs, fund sales growth and sustain continuing R&D needed to stay competitive in your business. They are not available to pay dividends to investors. As you talk to venture people, you should know that the "glue that binds" all this is the compensation structure. The bulk of venture investors' compensation depends on gains made on the situations in which they invest. If the venture does well, the entrepreneurial team, the investment managers, and the investors, all do well. If it fails, none does. Thus the perspective is accomplishment; having the product out in the market successfully with good margins in the future.

Let me shift briefly to university generated technologies. While venture people and their money can be catalytic, at the moment, I think they only infrequently are. Venture capital is not an alternative to grant financing, for reasons I've described. Technologies being worked on in universities often are too far from application; they are not proprietary; and transitional entrepreneurial people and skills frequently are not in place along with the technology. Those are three basic reasons why venture people are not more active in funding university technology.

On a more positive tack, I think venture capital has been and continues to be useful on a limited basis where a university itself is directly involved in a venture and has a vital interest in its financial return. One was discussed by Cal Tech yesterday. Some of your universities have investments in enterprises.

Interest in university technology is limited also by considerations of whether the technology has large potential. Where management is not in place, it has to be so large that it warrants the investors' taking time and effort to plan a business from scratch. This is a giant step. A number of examples exist of collaboration of venture people bringing business people together with scientists from universities to form companies with great potential. Spinouts from universities is a broader area for venture capital. There the venture is independent but the transitional business skills have already been recruited.

One result of spin-outs is that the knowledge-generating process of the academy essentially ceases as a technology goes into application and away from the university link. We backed a fusion physicist from a university in New York several years ago. I don't think that he could go back into the academic community and really compete on the front end of knowledge today. He's locked into a particular technological track. While he has done very well, he now is in the business of business rather than of knowledge generation.

The condition of the capital market, determines the availability of capital at any particular time. We have been through a very ebullient market in the last few years, in which technologies, generally have become highly overpriced, making reorganizations more promising as investments, for example. Values are racheting down substantially in technology now, to begin to make them interesting again.

The current interest in venture capital exceeds anything we've seen in 15 years, for all kinds of purposes, not just to back academic research. In the government sector, the printing presses are working overtime on venture capital's ability to create capital and jobs. Even the Catholic Charities of Brooklyn is interested in it to revv up declining neighborhoods.

With respect to the marriage of venture capital and university based scientists, a few issues frequently crop up in the relationship. The first is the question of valuation of the project. Someone yesterday said the inventor always thinks his "thing" is worth a million dollars. That's true. Th% tension arises from the investors view that the manufacturing and selling skills, also have important tangible value. Reconciling the relative value of each is a very difficult problem. As a rule-of-thumb in the venture business, the entrepreneurial team ends up with anywhere from 20 to 50 percent of the value of the undertaking.

A second issue concerns control and authority. The academic world is collegial. People from the academic community often feel there is no need for a chief executive officer: they've been colleagues among colleagues with everybody equal, and so on. Business generally requires a boss.

Finally, in dealing with universities, there often are too many agendas at work. Business works best on a narrow agenda. Institutions seeking to use venture capital frequently have other overriding goals besides making money. In government, for example, successful enterprises are sought. Investors see these as means of expanding their private capital. To the government, the taxable base of income is being expanded. You see the conflict. The agenda must be clear in a venture.

Summing up, universities can be sources and should become more important sources of promising ventures. Bear a few things in mind. First, few R&D projects lend themselves to a creation of substantial value through entrepreneurial

activity. Second, they are high risk. Third, most don't pan out. Proposals require careful screening against some understanding of what makes for a good venture versus a good grant opportunity.

A whole range of diverse financing and administrative vehicles can be used to sift out promising technologies if substantial amounts of venture capital are to be harnessed to commercialize research. Thank you.

MR. MERRITT: Thank you very much, Pat.

Our next speaker is S. Leslie Misrock. Les is currently a senior partner in the patent law firm of Pennie & Edmonds in New York. He has a JD Degree from Fordham University, A Bachelor of Science in organic chemistry from MIT and a Master's Degree in industrial chemistry from Columbia, University. In addition to his activities as a patent lawyer, Les is the founder and chairman of the board of Petroleum Fermentations, MV and Petroferm, U.S.A., which companies have been organized to develop commercial applications of certain technologies in the field of petroleum microbiology. These companies continue to expand research and development with respect to that technology.

Les is going to speak to us about a concept that he has of what he likes to call a multi-university Hudson Bay Company of high technology.

MR. MISROCK: Thank you very much, Tony. What I really have is a degree from Razorblade University. That's probably the most important one of all the experience and training I've got.

When I heard Pat speak about valuation, I was reminded of an actual experience I had about 25 years ago, when I sat at a negotiation between a lot of money represented by the Phipps Estate and a group of professors. They were haggling. One of the professors said, "We're worth 90 percent and the money really is stupid and unsocial. The money said, "Professors are nothing but peons and we are worth 90 percent." They haggled back and forth. They finally ended up with fifty-fifty, which is where they should have been in the first place. At the end of the table was old Henry Phipps, and as the deal was struck he cracked a smile. He looked at all the parties and he said, "I hope this doesn't work out like another deal we were in where they had all the experience and we had all the money, at the end of the year the positions were exactly reversed."

I am going to talk first about my learning experience in dealing with universities and the creation of Petroferm or Petroleum Fermentations because I think it's a great object lesson of what has been a very successful technology transfer. I will use this as an introduction and then move into what I regard as the important subject of today. I'll change your title, Tony, if I may, from The Investment Community as a Catalyst, because as an organic chemist, catalysts don't take part in reactions and they don't end up being involved, to The Investment Community As a Player Rather Than A Tire Kicker, which is the way I want to address the issue.

Years ago, when I was at MIT, there was a guy who lived next to me, who was the Westinghouse science winner at that time. He ended up becoming a physical organic chemist and a professor of physical organic chemistry at Tel Aviv University, having married an Israeli geneticist. Ten years ago, he writes me a letter about the work of two professors, both Americans, both in the Department of Microbiology, who, while walking along the beach, absentmindedly talking to

one another, step into an oil slick, in the center of which there's a clean ring of sand. Being microbiologists and more importantly, being curious microbiologists, they reason that there's a bug eating its way out. This observation occurred approximately twelve years ago. They isolate it, they misname it, they later correctly identify it as acetinatobactericalcoaceticus, the capsular polysaccharide of a complex lipoheteropolysaccharide, which turns out to be the best oil/water emulsifier ever patented. Because he was bright and he still is bright, he says, "You ought to look into this." This guy's judgment is so good that if he told me to go to the North Pole and look at something, I'd do so. The story has been retold and I think is quite famous. One of the professors was then on sabbatical at Roche Institute of Microbiology. I called him up cold, and told him to come over, as I would like to speak to him about his work. He says he didn't know who this crazy lawyer was and he figured he would go over and get a fancy steak dinner. When he came in and he sat down, we began to talk and I said, "Let's send out for a corn beef sandwich." He said, "That bastard had to be serious." That was the beginning of what later became Petroferm.

Now, in that instance, we cut that deal literally in 15 minutes. It was done by drawing up a letter of intent with the two professors who were involved in this work which had no legal effect whatsoever, but spelled out in exquisite detail the kind of a deal that I was prepared to make and fund myself. I was going to take the risk. I was going to take it because I learned to trust my intuition more than anything else, over a period of years. At the end of the letter, it said that if you agree, sign and I want you to apply your persuasion to your department and to the university. They both signed.

What happened was exactly what I predicted would happen based upon something that happened to me 29 years ago, when we represented four professors at Columbia University. They wanted to take a contract for over-the-horizon radar. Columbia was then being savaged by Mark Rudd and all the other Bolsheviks who were occupying the place. The Provost said, "You can't take the contract, absolutely not." So they formed a company, took the contract and laid it off to the radiation laboratory at Hunt and 25th Street. The Provost said, "You have to get rid of the contract." They said, "If we have to get rid of this contract, we take the entire Department of Electrical Engineering out of Columbia and we move it to another university. We'll leave you with the old men and no students." The Provost backed down. I never forgot that lesson.

The university is the faculty. My sympathy goes out to you research administrators because you are really between a rock and a hard place. On one side, you have got the inventive faculty. These egomaniacs who are brilliant. On the other side you've got the president--not the Board of Trustees, but the president and the vice president of research, who essentially say, "Look, do something, take care of these people." Your job, as I perceive it, is to close the deal, not to initiate, but to facilitate it once it's struck. Generally it will be struck at the level of a faculty member with a compatriate, with a money man or with another scientist.

Returning to my story, the net result was that we formed this entity called Petroferm. My function was solely that of a coach and it was to bring together a group of elegant scientists, not only from Tel Aviv, but from Poland, MIT, University of Texas and the Norwegian Institute of Technology. The latter happened to be a graduate student of one of the MIT professors who had an obligation to serve two years as a student professor of Biochemical Engineering. We

continued to pay him over those two years until he could fulfill that obligation and come with us full time. The business people are equally elegant because they come out of marketing and manufacturing.

One of the funny stories in the history of this company is when I had only $25,000 invested. I subsequently put in, over a period of time, half a million. I was offered a million dollars when I had $25,000 invested and I turned Roger Milliken down. But I got the best thing he had, which was eight guys out of his company, who joined and formed the backbone of Petroferm. We created a mutuality of respect. I have never met a university professor yet who hasn't wanted to do something useful. He doesn't know how. You've got to create that relationship, such that a marketing and manufacturing guy recognizes that this is where innovation is born; this is the cradle of ideas.

The American Chemical Society did a study some years ago of the major advances or inventions of the 20th century; Ziegler catalysis, Westinghouse Airbrake, xerography, etc. Interestingly, 80-plus percent of the advances arose at universities, small business, or from individuals. The corporations from which they arose, such as Bell Laboratories, were quasi-academic, rather than traditionally academic. I think one of the great legacies that Judge Green has left us, with his consent decree, is going to be an attrition of Bell from a quasi-academic institution to one that has intense, short term goals, and that's going to be the beginning of the downfall of one of the great research institutions in the United States.

So much for the background of Petroferm. It's a fantastic group because we have created a culture where there's excitement and where there is an interplay between the four universities plus this working group. Again, this mutuality of respect is absolutely crucial in the creation of any business or any venture.

Now, for the beginning of what we have been talking about today, and this is probably the first time it's being articulated. I hope that I don't undergo a lot of imitations of it until we get it started or done, but so be it if that happens. I think it's for public and social good.

My story begins with Chris Anfinsen and John Dearden of Johns Hopkins University visiting me. Chris is one of my experts in a case. He's, I think, the 1978 Nobel Prize winner in chemistry. I did something foolish, which was to volunteer, something I haven't done since I was a sergeant, to give a lecture on partnerships. I did the first one ever in 1955 with four German rocket scientists. For those of you who don't know what an R&D partnership is, a limited partnership is a creature of statute, which has a limited life and it is composed of a general partner, which can be individuals or a corporation and limited partners. The limited partners have limited liability up to but not exceeding their cash contributions. The general partner has unlimited liability. If the general partner is a corporation, then it must have a net worth of at least 10 percent of the value of the partnership, exclusive of its interest in the partnership.

The beauty of a partnership is that you can change the distribution of profits and earnings based upon contract, whereas in a corporation, you have a prorata share of stock and you stand or fall based upon that prorata share. It cannot be altered by contract. So, therefore, the limited partners can take all of the losses, 99 percent of the losses of the partnership, up to a certain point. They can take a certain percentage of the profits. Conceptually, the

partnership has two main tax advantages and it's always at risk, whatever the partnership, whether it's a research and development partnership or a real estate partnership. On a real estate partnership, you don't have to be at risk, but in every other partnership, you have to be at risk. The first tax advantage is that all expenditures for research and development can be expensed. The statute reads that you have a right to expense R&D expenses in the ordinary course of business. Suppose you don't have a business, suppose you are just a startup doing it for the first time. A very famous Supreme Court case called United States versus Snow, said that, "The public policy favors these deductions if there is an expectation of getting into business. Therefore, we will allow you to take the deduction, hence the loss, hence pass the loss on to the limited partners." That's a case which was unanimous, which is the basis of all R&D partnerships. Therefore, you can take and allocate the loss. These are not tax shelters; these are tax advantage partnerships, so that people putting up money can essentially write off 99 percent of the investment.

The second advantage is that you assume that something of value will be created. We will talk of intellectual property, whether patents or trade secrets or whatever. The transfer of that something of value can give rise to a capital gain, which in the case of individuals, is at the 20 percent rate. Interestingly, how does the person who receives the technology treat it? He is buying it. But because he doesn't know how much he has to pay, based upon royalties, he capitalizes the purchase and he depreciates at the rate at which he pays out, i.e., he expenses it. This is the only instance in the law where one guy gets capital gains and the other one gets a deduction. This doesn't happen any place else in that horrendous Internal Revenue Code.

Well, when Chris and John came up, they talked about whether or not an R&D partnership could be used to fund research at a major university. There original idea was that they wanted to form a 501(c)3 as the general partner. I said that would be the kiss of death because the mentality of a foundation is not the driving force to make a business work. I said that what they really needed is what I will call the Hudson's Bay Company of Technology Transfer. Why do I use the term Hudson's Bay Company? Recall your history. You had the English Barons who put up the money and a group of explorers, adventurers, et cetera, composed of soldiers and administrators and whatever, who carved out of the wilderness a nation, facilitated by the use of companies such as the East India Company.

Let's consider how this might work if we had to define the ideal and work backwards to assemble it. Let's give it the name Research Management Corporation because I can't think of anything else at the present time. We will use for illustrative purposes, two universities, John Hopkins and the University of Pennsylvania, who will be the recipients of $100 million in research funds over a five year period. This is a very important point. In every contract I have done with university professors, they don't look for royalties so much as they look for funding for research, but the most important, single factor that I have found with professors is continuity. They have to go through an awful peer review program. I call it awful because it has reached the point of reduction ad absurdum. They spend between 40 to 60 percent of their time writing grant proposals and they are not reimbursed for those grant proposals. One of the things that we have found was that when we identified the person with whom we wanted to work and by the person, I am not talking about the Nobel Prize winner, et cetera, I am talking about the young post-doc or the untenured assistant professor who wants to bring in one or two post-docs and one or two technicians and equipment. They are exhilarated about the idea that they would get five year

funding for a project and don't have to go through the peer review process each year. Sure, they could change direction, but if the program was good, you are prepared to stick with it over a five year period and fund it accordingly. They know the money is there for that and we found that this assurance is a great turn on for gifted scientists.

This Research Management Corporation, if it is created like the Hudson's Bay Company, would be the general partner of what I call Genesis I, the first partnership. The biblical expression is appropriate for the creation of technology and creation of ventures. We are talking about how do we create a mechanism to raise between one to two million dollars for university research from the private sector; from players, not tire kickers, over the next seven to ten years.

Now, let us consider commercialization. An investment obviously comes into the corporate general partner and flows to the limited partnership called Genesis 1. In any technology, I don't care what it is, there are only four routes to exploitation. I list them as licensing, new ventures, leveraged buyouts and joint ventures. You all talk licensing. This is the worst way to exploit any technology. What happens? Knock knock, I've got a new idea. Take a look at it. You go to a corporation that's reviewing 6 or 10 or 15,000, and the guy who receives it doesn't tell you that he has a problem selling it internally to his own management because they don't want to put their neck on the line with respect to something. Inevitably you get beautiful receptions, lunches and nothing happens. Rarely do you find people who are prepared to really make something work. But if you go the licensing route, you must find the human being, the receptor at the other end who is prepared to make it work. Don't be mesmerized by the size of the corporation or the name, because they have their cultures just the way university departments have cultures. Find and identify that individual who will make it work if you go the licensing route.

It's acknowledged, I think by all of you, that the most successful university group is WARF. Over a period of 50 years, Howard Bremmer once told me that they had reached and raised a hundred million dollars. Then he subdivided it and showed me that it was 35 million from licensing and 65 million from portfolio and real estate investment over 50 years. $35 million is no big deal. If that is the best that the United States has to offer, the system isn't working. Technology is not being transferred properly.

New ventures can either be internal, if the corporation develops its own technology, or external. External new ventures work because the venture capitalist brings together a group of scientists and a group of business types and hopes that a mutuality of respect can be found and established. I don't care what the technology is; high tech, medium tech, low tech or no tech, the thread of commonality of success that runs through all of them is a leader who is obsessed with making it work. When you find that leader and money, invest, and then you can make something work.

A leveraged buyout, essentially, is buying a company or a division of a company. You are working for the banks. Quite frankly, unless you can give it an injection of technological adrenalin, all you have is the experience of working for banks until you essentially have reached a point where you are paying it off and using high leverage to bring it public again. It can work for technology exploitation if you have and use it as a vehicle to advance what you want to do.

A joint venture is participation with equity, plus licensing, whether on a lower level or not. It means you have taken some of the risks out of the joint venture. Why do you want to be in it rather than licensed? Because you don't want the idiots on the other side to screw it up. You want to be inside to have the power of influence, not necessarily the power of the vote. You want to make sure that you are heard from on the way this thing is being exploited.

When you think about it, these are the only four ways that any technology is exploited. I put to you that any technology transfer from universities, collectively or singularly, has to be able to go through this interface and go through one or more of these four methods. If it can only go through the licensing one, it goes through a venturi throat and inevitably, it's going to be held up and undergo a high degree of failure. The amount of risk that is taken at the university level is minimal compared to the amount of money required when you scale anything up.

In any R&D partnership, the source and flow of funds really comes from the money that's put up for the research effort, which usually amounts to about 70 percent of the total. Off the top comes the seller fees, et cetera. These things really should not be done on a small scale. In my personal judgment, they shouldn't be done for less than a hundred million dollars per partnership because they are ultimately destined to become mutual funds in high technology businesses. The universities are looking essentially for research funds. The kickers are participation and profits; participation and equity; or essentially bootstrap additions to their own foundations. They really don't look for, in my personal experience, the royalty. They look for the source of funding for the research. If royalty comes, fine, but they don't make the deal dependent upon the creation of a royalty flow or stream because there's much risk between that sort of negotiation and the creation of a business to work.

In thinking about how to make this work, we draw up an organization chart of what a research management corporation would look like. It is typical of any corporation, with one difference; the finances. Before we talk about how to fund this corporation and how I intend to fund it, the financial group really is more than just a group of bean counters who watch where the money's being spent. It is an internal investment banking group who is capable of structuring the kind of deals of the type that I previously described. The most important single entity here is what I call commercial development. I subdivide it into biotechnology, material sciences, electronics, telecommunications. Of course, this is arbitrary but it is based on what I saw at a site visit down at Hopkins. If I really spent time on it, we would have to expand that list to page upon page containing subdivisions of technology, which in the totality, represents what's being done at a major university.

The important thing in any commercial development is that there is a recognition of an ultimate need. Fill a need, you will find a market. The successful people in commercial development are those who recognize needs, communicate these needs to people who want to do research and who will say, I have a solution to that problem; I want to solve that problem; I want to work on that problem.

The counterpart of commercial development is university research monitoring. I do not call it management. I think that would be scandalous to a professor if you said that you were to manage his research. All you want to do is monitor his research.

I have drawn up literally hundreds of contracts with universities. They all call for four quarterly reports and one annual report from the professor and that goes out a window. None of them pay any attention to it and unless you are there to rap with the guy on a monthly basis, you don't know what's going on. But if you are there, you can turn him on as much as he can turn you on.

I have just used the two universities as illustrative because you want to cycle people from monitoring into commercial development and vice versa so that there's a glow around those two. You want people who are reporting and encouraging these people, stimulating that research, and then seeing how you can package a collection of that into what is a coherent business plan. That's not the function of the university. The university doesn't have the culture to create business plans.

Just to finish, when we determined that amount of money that would be required for this corporate general partner to use, the professionals perform a peer review for science which includes locating the right young post-doc, or the right professor, who really wants to work and who needs money and can be funded. Marketing and manufacturing has been explained. Internal investment banking has been explained. Where does the money come from? It comes from venture capital which can be a gatekeeper for creation of new ventures to the whole community. It can come from a service house which has a product to sell and a local patron who wants to do something for the university or the community. Or it can come from an institutional investor or investors or a corporate investor or investors.

The latter have two criteria or should have two criteria for providing capital. One is, give us a window of opportunity to do things and secondly and equally important, tell us what not to do, what we should not be investing in, because there is technology out there some place that is causing obsolescense.

I am sorry I have run over my time, but I wanted to give you this broad concept and idea.

MR. MERRITT: Thank you very much, Les.

Our final speaker of this session is Walter Channing, Jr., who is the Managing Director of the C. W. Group and Managing General Partner of two venture funds, C. W. Ventures and C. W. Research and Development Funds. These funds are venture capital pools totalling $60 million, devoted exclusively to the health and biological sciences. The limited partners in these funds are ethical drug companies and insurance companies.

Walter is a graduate of Harvard College and Harvard Business School and spent his early career developing a consulting business, Channing, Weinberg and Company, which advises companies in the pharmaceutical and biotechnology field. Walter will speak a little bit about some of the activities of the venture funds which he manages.

MR. CHANNING: Thank you very much. Fred Bentley asked me to come here today to be a catalyst. So the first thing I did was organize a cocktail party, and I hope you all come.

Fred asked me if I would make a speech. I thought that was great. But the issues that have been raised here suggest that some big problems remain for the venture capital community. Frankly, my own view is that the discussions that are going on here, thanks to this organization and its timing, are serving as a solution to these problems. The organization can be considered as a solvent. But I am not a chemist. If it's solvent that's getting the action, don't give credit to the catalyst.

Yes, I am in the venture business. We manage what I think is the largest pool of directed funds for a particular industry, i.e. the so-called health care and biological sciences fields. Our charter requires us to invest in those fields.

I will give you a few characteristics of our business. First of all, we do invest in properties at the very, very earliest stage. We are very active in the projects we invest in and we stay close to them. We have technical staff in our group. We have extensive contacts in the industry in which we invest and we use those contacts. We have both limited partners and arrangements with other companies and we find that to be a very important part of our business. We often start companies from scratch and bring together a management team. We will create a company around an interesting technical project. We have invested in everything from sensor technology, diagnostic imagery, diagnostics, nutrition, materials, therapeutics and a whole variety of other topics.

As evidence of the fact that we believe in your concept here, we've recently organized a fund which may be, in our view, a precursor of other kinds of funds that was really created to meet the needs of the audience here. I know of no other like it. It is not a Hudson Bay Company but it may be a small step in that direction. It's an R&D fund, which will invest up to half a million dollars in any given project. But we have no lower limit on that investment. It will support a project that's still in a university setting, or a laboratory and it will give $20,000 for a pilot study to bring a piece of technology to a point where the risks can be better ascertained. If it's deserving of additional support, we will provide that support. This fund does not require extensive plans on the part of those seeking the funding. Alternate R&D plans create overhead and overhead is premature in any technically based situation. We also don't require management overhead in most of these. Finally, while this fund is relatively small, substantial later stage funds are available through other funds managed by our group. So I find us backed up by deep pockets.

Now, the premise of this fund is that a collaboration between venture funds and the university can be made. That a significantly funded interest exists is a useful and desirable concept for a university. We want universities, their staff, their subsidiaries, their endowments to be involved. I feel that this collaboration is an inevitable trend in the course of things and it probably will be widely copied. But let's go back for the moment, to the role of a catalyst, which is what I have been asked to be.

Let's look for a second at the status of venture capital in the academic community. I am going to comment on some recent business publications, which you would find in your local newstand. Venture magazine was created by the venture capital industry and interestingly enough, is the fastest growing business publication in the United States, both with respect to subscriptions, readers, and advertisers. In a recent issue of Venture magazine is a cover story which shows on the cover a man being interviewed. But he is not a business man, he is

an immunologist, and he is a department head for a well-know western university. He is being interviewed in this cover story by the journalist who is accompanying him on this 85 foot yawl. In the course of the interview, he doesn't get much into his business activities but the immunologist is making a major point that his academic footing, during the course of his involvement in a venture capital business, actually improved. The department has published more, the faculty have gotten more grants, and the applications of hot, young students and graduate students has increased. In fact, implicit in this is that we have an enormously successful academic career but not coincidentally, the photographs show the 85 foot yawl. Now, also on the cover is another guy back behind the mizzenmast that you can't see clearly, but he is a biologist from Yale University and he is being interviewed too about a possible transfer from there. So the Venture magazine story tells something else as well.

Looking at another example is a recent issue of Forbes magazine that appeared on the newstand. This issue was devoted to listing, describing, and biographing a list of the hundred richest scientists in the United States. Forbes, as you know, is responsible for an issue of the 400 richest people that we're very soon going to see. I think, it may not be Forbes, but rich scientists that are of interest to all scientists. It doesn't always make you popular, but it sure does make good reading and sell magazines.

The final stroke comes when a popular science magazine dedicates a story to fund raising by taking departments public as a way to raise additional venture capital money.

We think a major role does exist for venture capital in supporting R&D; more D than R, I might way. I think that unlike the rest of the venture capital business that you hear about, we have to come up with a substantially greater amount of management strength, direction, and effort in working with university based projects. I don't think we mind that and I think that a major carried interest, in the form of equity participation, is possible and desirable when it's creatively designed. I don't care whether it's a for profit subsidiary, a not for profit subsidiary, an endowment, or an affiliate. That is irrelevant to us as long as the university and the technical staff are involved.

Although we work with the major ethical companies in the United States, I have to agree with some of the prior speakers, that an equity interest is a lot more promising than an institutional arrangement that provides future royalties which accumulate in the distant future and the present value of which is relatively small. The classic licensing arrangement should be avoided when venture capital alternatives are possible.

I think the biggest challenges we face in working with academic groups, are basically communications problems, and mismatched expectations. Both sides must be very careful to realistically assess what the joint exercise will yield. It's unusual to find a situation where everybody has the same target in mind. I think venture capital and academic scientists must learn to speak the same language. Again, a communication problem. Setting goals is what is needed. A market opportunity must be quantified in terms that everybody can understand. R&D people must understand our need to prioritize a project, to allow for a staged funding, and to facilitate market entry.

Much of the responsibility of this R&D really falls on the venture capitalist. But it's surprising, once that communication is made, how a scientist turns out to be as clever in finding the path of least resistance to a market. They often serve as a major contributor to business strategy, once they understand the nature of the project at hand.

I suppose I am asking myself rhetorically the question about what advice could I give to a group like this. I guess I think of entrepreneurship as an approach to applied development. There is venture capital there. We have formed a fund and there are other funds. I think there are going to be more coming, despite what is presently, now a relatively difficult market. As we pointed out, markets do change.

Despite that I've heard about how great the large companies are and with no disrespect towards them, in the ethical drug deal, which we know extremely well, internal research is enormously unproductive. By their own admission, companies such as Merck, Lilly, Smith-Barnes, Squibb, Warner-Lambert, Roche, Pfizer are having very difficult productivity problems internally and they're turning increasingly towards external research for new products. I might add that six out of seven of that group are limited partners of our fund. They're very disappointed in what's happening internally, and the entrepreneurial routes are becoming increasingly popular. No greater players of importance exist in that equation than the independent research organizations that are housed in universities, teaching hospitals and other locations.

A second piece of advice is try to get a better marketing perspective. Try to understand the environment of alternative financing sources a lot better. Develop a strategy and try to prioritize ways to get access to the right type of capital. I frankly see the era of growth of NIH and NSF funding as passing. I ask you what I asked some of my dinner guests last night. How do you handle the following event? Your faculty work hard on an NIH grant proposal, its submitted and approved but unfunded. What is the answer to them and how do you react to that kind of event? Try to establish a rigorous list of the locations, and the requirements of new kinds of assets for supporting research and development. I think this group can contribute in that direction.

I just recently returned from Japan and visited 18 drug companies in Japan. Their willingness to sponsor external research on very favorable terms, I think, is something of which we'll all begin to see the benefits. Someone needs to come up with a comprehensive way for you to understand what's involved in the access to this so that you don't waste time with what we've heard referred to as the tire-kickers.

My last piece of advice is that you have to make your thinking verbal. There's a great deal going on outside the United States on a multi-national basis where an effective university can negotiate much like creative writers have learned to negotiate for rights in their work outside the United States. In a very selective way, universities as creators of research products, have to be more sophisticated negotiators.

I think finally, once you have ascertained what that market can do, match your ambitions to those possibilities. Listen to the feedback. I don't know of any systematic feedback on what industry thinks about a particular project. You get individual responses, but there's no mechanism to get feedback and I think that's a real problem.

The better prepared you are, the greater chance you can avoid what I call the two big gruesomes. Gruesome No. 1 is where you becomes weary with negotiations and where the time and effort of negotiations exceeds the value of what the project is, but somehow you can't stop. It's a horrible situation to be in but it can be limited by understanding before you get into that, what your options are. Gruesome No. 2 is never knowing, as a result of discussing a project with two or three different sponsors, whether that represents the opinion of the universe or is merely the opinion of those two you did talk with. That leaves a project that's unfunded with a strange question mark over it; is it applicable or isn't it applicable? That lack of knowledge is what I call Gruesome No. 2. I frequently see projects that have been turned down by a single drug company, but the group has attributed that single turn-down to the opinion of the whole universe.

If you can't get venture capitalists, move to corporate sources. Corporate sources are becoming increasingly flexible when coming to deals that you can make. Up-front payments for support of research are becoming increasingly popular. It may reduce the upside; moving your corporate source away from a venture capital source but it can be attractive in my view.

Lest I forget, as the role of the catalyst, the other side ain't perfect either! The venture capital community ought to be commented upon. Venture firms are a very varied lot. Some are respectable and others are not. Some work hard and some don't. Some can provide the interfacing assistance. Others simply don't have the expertise. So some final advice. Be selective when working with a venture group. Find out about their track record. Be investigative. Talk with others with whom they have worked. Get the names of their limited partners and contact them. Make sure the venture firm has capital under management and is not merely a deal-maker who puts together deals, that is, obtains a commitment from you and turns around and tries to raise money on the basis of your name. I guess I would have to define a Gruesome No. 3, which is where there's no deal until you sign and then there's no deal until they raise the money.

My final comment would be, for those of you who have discussed and are considering building incubation centers for new businesses, my only request would be, please make them lean and if possibly a little tacky. Nothing sets the wrong example for a venture we fund, than expensive quarters and animal facilities that represent a lot of overhead. I would far prefer them to rent a local garage and let those entrepreneurs learn how to make that money stretch and not set the example of an over-built facility.

Thank you very much.

MR. MERRITT: Thank you very much, Walter. We are very tight on time, but we will try and take a couple of questions.

Les Misrock was asked, "In your R&D Limited Partnership Model for university involvement, who would do the manufacturing and sales of products and processes, the general partner or some other entity? Would the royalties pass through the general partner to the university and the faculty who originated the technology?"

MR. MISROCK: Those are two questions and the first is, who would do the manufacturing or the marketing? It would be the purpose of the corporate general partner to serve as the interface in laying off that technology in one of the four modalities which I discussed. If it means raising the additional funds or whatever to either buy a business, do a leveraged buy-out, or create a joint venture, it's the function ultimately for a dedicated business; not by having the corporate general partners do it as a business, but package it, raise the additional funds, including the staffing of it.

With respect to the pass-through of royalties to the university and individual researcher, I will give you my personal experience and that is, in every deal I have done with different university departments, I have always made the individual principal investigator a party to the agreement. I have always stated to the department head and to the provost, that if that guy picks up his baggage and goes to another university, the contract goes with him. We are investing in people, not in bricks and mortar. There is a standard provision in most of my agreements that says that if he dies, the project automatically terminates unless the university can furnish an acceptable principal investigator. The universities have asked for this. This is an intensely personal relationship. I have made them a party to the agreement because I want them to have the security of knowing that they, individually, are to have a piece of whatever benefits, accrue as a result of this. Not merely the research funding, but they have a stake in the creation of whatever comes out of their own intellect. I regard that as mandatory in anything that I do. Involuntary servitude went out with the 13th Amendment.

MR. MERRITT: Thank you, Les. We have had a couple of questions having to do with venture funding and whether or not it would support basic research. If it wouldn't, what other sources are there for funding pre-venture R&D? I think maybe we have somewhat conflicting views on that between Walter and Pat as to whether venture capital could support basic research.

Would you care to comment on that?

MR. CHANNING: I don't disagree with Pat on the timing of returns. Where there was an implied component that needed further development and refinement we would support basic research. As an example, support for, I suppose 50 percent applied and 50 percent basic research to support a more commercially advanced version of it would be appropriate. It is unlikely we would do something of a nature that was perhaps producing something only after five years or so. In many projects in the biological field, for example, we will develop a prototype version of a product that still needs basic research done to it before it can be potentially created into a commercial version. So, therefore, we are supporting basic research to a degree.

MR. MERRITT: Pat, go ahead.

MS. CLOHERTY: I think that I agree with what Walter just described. But the mainstream venture practices unlike the specialized fund you set up, prefer to take things that are fairly close to application rather than funding basic research. I repeat that I do think it is a mistake for would-be entrepreneurs to overlook the other segments of the capital market, such as "family and friends", or "doctors and dentists." Those are individual investors who tend to look to a tax oriented investment. We personally will make $35,000 to $100,000 available to take a technology a next step. These projects tend to be too early

for institutional sources of capital. The advantages of tapping noninstitutional sources are that entrepreneurs tend to get somewhat better values when people put their own money in to back an individual. You really back the person and you are not operating under a strict return standard. Early stage monies tend to be, under any circumstances, rather expensive monies.

MR. MERRITT: The question has been asked about the degree of financial risk of the entrepreneur who gets involved in a venture capital financing arrangement. "If the plans fail to materialize, does he lose his house?" I guess, what is the risk to the entrepreneur who takes venture capital?

MR. CHANNING: Well, it really depends on his financial profile. It's a little discomforting to get involved, let's say with immunologists, who have got a lot of money but aren't willing to put any up in a project. On the other hand, I don't think his project should in any way or shape jeopardize his lifestyle in any way, if the project doesn't work, even if it's his assertions that don't prove to be correct. I think there's a great deal of financial suffering but the guy still has his yawl, then he'll have to live with that. As a practical matter, many successful ventures have come about subsequent to prior disappointment. I think one of the great benefits of this system is that the researcher can learn from failure as much as from success. We don't want to ever penalize someone or take his house away or put him in any kind of jeopardy at all.

MR. MISROCK: I would like to also comment that in anything I have done involving individuals who wanted to become entrepreneurs rather than just stay at the university, in other words, leave the university and join a biotechnology company, I want them at risk. I want them to take it seriously, and not just have the opportunity to take stock or paper or whatever, feel wealthy and then walk away. I want them interested so they just don't pick up their marbles and go someplace else. I don't care what the risk is, whether it's five thousand or ten thousand, if they can afford it, I'm prepared to lend it to them personally, but I want a person to be at risk and take seriously participation within a business. That's a measure of how strongly he feels about what he wants to do. That's my old zealot theory.

MR. MERRITT: One other comment.

MS. CLOHERTY: Just a point. With us it's axiomatic that the entrepreneur or the scientific entrepreneur should invest to the extent he or she can.

MR. MERRITT: We are running out of time. There's one final note I would like to make. There was a comment made this morning by one of the speakers in the earlier panel who was wondering what the other four institutions that had survived from the Reformation were. Don Langenberg, who was absent from the room at that time, has volunteered to tell us.

MR. LANGENBERG: According to my source, it's the Catholic Church, the Luthern Church, the Parliament of Iceland and the Parliament of the Isle of Man. Now, that raises some questions in my mind and I intend to explore those further. Let me tell you what the source is so you can review it as well. I ran across the quotation, in the inaugural address of Jim Zumberg as President of USC. There's a footnote that says that he took it from one of the Carnegie Commission Reports on higher education. One added note about the quotation, and since I

reproduced it from memory I may not have it exactly right, it must effectively exclude the private sector. Yesterday Herb Fusfeld pointed out that there is at least one private company, a Swedish company, Stuhr-Koppersberg, which was chartered in 1492 and still functions today.

There's obviously all sorts of opportunity for historical research in this area.

MR. MERRITT: That's a good one for you Trivial Pursuit fans, obviously. I think we owe our panel a little hand here and I would like to thank them personally for their contributions.

LUNCHEON ADDRESS

AN ENHANCED UNIVERSITY ALLIANCE
WITH THE PRIVATE SECTOR

MR. BENTLEY: It gives me great pleasure to introduce to you Julie Norris, who is the Assistant Provost and Director of the Office of Sponsored Programs at the University of Houston-University Park. Julie will introduce this afternoon's luncheon speaker. Julie is a very active member of NCURA and is currently NCURA's Treasurer. Julie.

MS. NORRIS: Good afternoon. As all of you who have been sitting through the last couple of days know, the conference that we have all been attending has been addressing ways to make the alliance between the universities and the private sector a positive, dynamic relationship that has great benefits to both of the parties. Our speaker today will address elements of that relationship as a spokesman of the academic community and as the Chancellor of a university, actively engaged in building a strong, productive relationship with the private sector, while at the same time preserving the traditional academic values of the university.

Dr. Richard L. Van Horn has been Chancellor of the University of Houston-University Park since July of 1983. He came to our campus from Carnegie-Mellon University, where he had served in a number of senior administrative positions since 1974. He had joined Carnegie-Mellon in 1968 as a faculty member and as Associate Dean of the Graduate School on Industrial Administration. As evidence of the breadth of his involvement in university affairs, he also served the university as a Provost, as its Vice-President for Management and as its Vice-President for Business Affairs. During a two-year leave of absence while at Carnegie-Mellon, he was Director and Professor of Management Systems at the European Institute for Advanced Studies and Management in Brussels, Belgium. Prior to coming to Carnegie-Mellon, he worked at the Rand Corporation as a researcher, as the head of the Management Systems Group, and as the co-Director of the Management Systems Laboratory. He received his Ph.D. from Carnegie-Mellon, an MS Degree in Industrial Management from Massachusetts Institute of Technology and a BS Degree in Industrial Administration from Yale University. His research and teaching interests are in Systems Management Strategy and Policy, in Information Systems, in Computers, in Simulation and Educational Management.

Other professional activities include service as a former Secretary/Treasurer of the Institute of Management Sciences and as Department Editor of Management Sciences, and as a national lecturer for the Association of Computer Machinery. He's currently Chairman of the Visiting Committee for Information Technology at Harvard University, a Director of Glosser Brothers, Inc., Chairman of the Board for the National Center for Higher Education Management Systems and Vice-Chairman of the Board of Educom. Since coming to the University of Houston as its Chancellor last year, Dick has clearly articulated the extreme importance of research to the academic community and has emphasized the particular needs of our university for a close alliance with the private sector in reaching the research goals of the institution. Clearly the extension of research has become a primary role of our campus and a role which can be achieved only by broadening

our base of research support. To this end, he has actively supported the growth of centers and laboratories as well as spearheading the development of a computer intensive environment throughout the university.

Some of his comments today will be directed towards the changes needed in the future to enhance the Private Sector/Government/University Alliance. I am certainly delighted to introduce you today to the Chancellor of the University of Houston-University Park and my boss, Dick Van Horn.

MR. VAN HORN: Thank you, Julie. I'm sorry the budgets are set for this year, but believe me I will remember your introduction next fall.

Actually, all those things Julie said about me are nice, but when a Houstonian gets invited to speak at Dallas, that obviously will go in my vitae for the the next conference. You have to recognize those things.

Dallas was the location of another event last month, where many good things were said and many things were promised. I am hesitant in a sense to get up on this platform, having listened, at least from T.V., to some of that rhetoric.

I think there are two broad themes that will affect university and private sector relationships over the next ten or 20 years. One is that the U.S. really has changed. The U.S. economy and the U.S. society have changed and are changing. Of course change takes place more rapidly now than it did in past years and we're all aware of that. I believe that the implication of this change is that the universities must change and I'm not sure there's broad recognition yet that the university/private sector relationship will require some significant changes for universities. Universities cannot really go on as they have in the past, and change in a university is always painful. It probably is more painful than it is in the rest of society.

Why would we say that the economy is changed? I think you have probably heard many of these things before. Let me read you a brief quote from Daniel Bell, which I think makes many of the relevant points. "The crucial point about a post-industrial society is that knowledge and information become the strategic and transforming resources of the society, just as capital and labor have been the strategic and transforming resources of the industrial society. The critical variable for a society, therefore, is the strength of its basic research and science and technology, its technological resources, its university and research labs and its capacity for scientific and technological development." Well, we might quarrel with some of the specific points of that statement. For example, one might believe that intellectual capital is a form of capital just as other forms of capital. So maybe things haven't really changed as much as Daniel Bell would suggest, but I think things have changed.

If you ask what's the role of the United States over the next 25 years, I think you answer that question that the role of the United States in the world economy and in the local economy is that of an innovator, of a researcher, of a developer. That's, in a sense, been the role we have excelled at in recent years and it is not always well recognized. We talk so much about high technology, that we forget it isn't really manufacturing solid state chips that is our strong point. It's been the innovation and the development, sometimes the development of new manufacturing techniques. It isn't that producing new technology products by themselves is good and great. Obviously a lot of electronics production has been exported to Asia and to other locations. So that certainly

is not what's going on. It's been the ideas, the innovation, the creativity that has become the role of our society. But the relative importance of creativity, of innovation, of research, of development, has gone way up in our society and that is a significant change.

Now, one would believe that universities will play a key role in a society where innovation and creativity are important and where intellectual productivity is important. Everybody talks about productivity and how the Japanese are more productive than we are especially when you think about producing cars. That's probably not where the real possibilities and the real challenges of the future lie. The challenges of the future are intellectual productivity. Think of the engineering shortage. If our engineers were five or six times as productive as they are today, and I think that's possible and there's some good ways to do that, then we wouldn't have an engineering shortage. In fact, we might have a surplus of engineers. So intellectual productivity is going to be terribly important over the next 15 or 20 years. It's an area we don't know very much about. We haven't really ever thought very much about intellectual productivity. It's hard to find anybody writing about intellectual productivity. You can't buy any handy approaches to intellectual productivity. There aren't any little home and mother rules, none of the kinds of things we know about. Physical productivity exists in intellectual productivity.

Well, that's an interesting challenge for a university. Universities are involved in education, universities are involved in research. We are centers of intellectual productivity. Learning is a basic intellectual process, and so we should play a very important role. If you ask are we the critical factor in these areas and do we get substantial support for interaction with the private sector at the present point in time, the answer to that question, I think, is much less clear. The last numbers I've seen are there's about 90 billion dollar's worth of research and development going on in the United States. Most of you know that universities do less than ten percent of that. By those numbers, we are not important. But if you look at basic research, we appear to be much more important. We are perhaps 50 or 75 percent of the basic research establishment.

In education, companies obviously do a lot of education. They probably do as much as the university system in terms of total dollars. Again, we are about a 80 or 90 billion dollar a year kind of operation. The total external support for education and research is less than ten percent of the support coming to universities. In education, that's only one or two percent of the funding coming into universities. So we are not the dominant or certainly, if you believe in strategic planning, it's not clear that we dominate the education market. It's not clear that we dominate the research market, although we may dominate some sub-set of that. We are not being highly successful at this point in time in getting industrial support. So I think we can say there's a lot of potential for industrial support to both education and research, though not much of it's coming to us. We will have to make some changes and do some things differently if we expect to be much more important in the future.

Well, what are some of the issues? Assume that we would like to be major suppliers of education and research with support from the private sector. I won't belabor these issues because I think most of you have thought about them. Let me just try to suggest a few highlights. One of the biggest concerns, when you start talking about industrial or private sector support for universities for education or research is the issue of intellectual merit. Companies tend to

relatively short term and highly applied goals. You all have heard many arguments about applied versus basic research. If you start getting large amounts of money from the private sector, will you end up doing relatively uninteresting applied research? I think that argument is an argument that's a little bit short-sighted. What we probably should do is back off one level and we should quit worrying about applied versus basic research. We have never been able to define it very well anyway. What we should set as our basic criteria is what we're already doing anyway. If a research project has a potential, a high potential to result in the generation of new knowledge, we should consider that as a desirable university project. If it does not result in the generation of new knowledge or if the potential is low, it's undesirable. I think that's a much better criterion than worrying about the old question of applied versus basic. Applied research often results in generation of substantial new knowledge, and to the extent it does, that's good. In a similar manner basic research projects that are unlikely to result in the generation of new knowledge, probably are less desirable. Maybe we need to quit worrying about this heavy emphasis on applied versus basic research and go back to our basic definition, that if we generate new knowledge, those projects have intellectual merit in the university environment. We have a lot of examples now that get used very widely so that we don't have to worry about being too narrow in many cases.

I think control is the second issue that is of concern. Control, when you talk about individual research projects, is not a significant problem. If Shell wants to control too tightly a research project, you don't do any more research for them. So on a project by project basis, it is easy to deal with control. You simply don't deal with sponsors who want to control too tightly. Where you have problems is where universities make major investments and then it's very difficult to back out. For example, my former institution, Carnegie-Mellon, in undertaking a major research project with IBM where IBM committed substantial funding in excess of 20 million dollars to the university, committed to building an eight million dollar building. Now, you really worry about control in that circumstance because that eight million dollar building was being paid for over the next five years with the revenues that were coming from IBM. So if you don't like the kind of relationship, you can't really say to IBM, go away, we don't like you any more because then you're left with a very large front-end investment. In such cases you have to worry, I think, a great deal about control. In the example cited, there were very high costs associated with the relationship and it would be difficult to walk away from that particular relationship.

Intellectual property is another issue that has generated a great deal of discussion. I will give you my biases and announce them plainly as my biases. I don't believe universities will ever get significant amounts of money out of patents and royalties or anything else like that. I think it's really, a very diversive argument that takes us off in all the wrong directions. My own personal belief is, any time an industrial company wants the intellectual property rights, we should give them to the company with enthusiasm and the appropriate front-end charges. Basically, you should encourage sponsors to take the intellectual property rights because the goal of the university is the dissemination of knowledge, and the best way to have knowledge used, the best way to really see the knowledge transfer is to have the company with a stake in the idea. If they own the intellectual property rights, they're much more likely to be concerned about how those ideas get developed and put into practice. That's the contribution to society. A patent doesn't guarantee that a company will

make a lot of money as profit. Generally profits, as we all know, are relatively small. The fact that the company is going to take an idea and make a profit on it is really irrelevant to the long run progress of society. A patent that gets used by a company is far more valuable to us than a patent that doesn't get used by anybody. We shouldn't really worry about all the peripheral arguments of unjust profit or monopoly kinds of positions or anything else. You kind of worry, I guess, about the suppression of ideas, which is a legitimate worry. But by and large, we probably should give away intellectual property rights at the beginning, and get the best price we can for this very uncertain commodity. I think a lot of the universities really believe they're in the New York State Lottery and they're expecting any day now, that they're going to get that ticket worth 40 million. We know it happens, but the chances that your university will have the right ticket is small. It's not the kind of thing you build a research base on.

Publication rights, of course, as a lot of people have pointed out, are important. Universities are involved in the generation of knowledge for society and it's difficult to be involved in a situation where you can't publish. But most industrial companies are willing to deal with that issue and allow publication.

I think another real problem for universities is net benefit. I'm shocked continually in dealing with industrial companies, that they think of us as a public service. We happen to be a public university, which means the State of Texas pays us for teaching. We're not a public service function. If we do research for a company, the only way we do that research is if the company pays the full costs of the research. I think that's not well understood. We're not in the business of doing research somehow for cut-rate prices. We're not going to cost-share with industrial companies. I think that's an improper use of societal resources. We should be demanding full overhead and we should be getting full overhead. I think if we're going to engage in these relationships in the public spectrum, we ought to have a clear understanding that private companies that support research in universities should pay the full cost. I think that's not clearly understood, and I think it's very unfortunate that all of us, because of financial pressures, tend to engage in various kinds of discounting and price-cutting. We cut down overhead or we agree to cost-share. I think we ought to be a lot tougher on that, I think it's good for everybody if we can be tough. In the long run, if we do a lot of research below the true cost for industrial companies, we don't help the university system, we really weaken it.

There's a final argument that again, I think is of great concern and that's the distortions of efforts in the institution. All of us have that problem, and none of us really know how to deal with it. But the problem is simple. The money that comes in from the private sector, by and large comes in engineering and science. Interestingly enough, business schools get very little support from the private sector. If you go out with an engineering project, as many of you know, you may get support for it but you don't get support for the business school, and you certainly don't get it for the history department or a lot of the other humanities or fine arts. So we will tend to distort. As we see a major role for the private sector in supporting activities at universities, we will tend to distort. That, I think, is a concern for all of us. Science and engineering will grow. Courses that are most directly related to professional activities will grow. All those kinds of things will happen to us. One of the things that universities have to do and indeed, one of the things we do is, behave in a way that seems strange and almost seems unreasonable, but because

engineering or science can generate external funds, we engage in what might be unfortunate for the institution in the long run. We take money away from the engineering and sciences internal university budgets and we give it to the humanities and other areas that have a hard time generating funds. While it seems reasonable to all of us, note that it does have a serious problem in that engineering knows that the more money they generate, the less they're going to get inside. It's a little bit difficult to develop high levels of enthusiasm. I think they are better off, but that's an unfortunate problem that we all face, that if we're going to do a lot of external research, we have to do some reallocation inside and that reallocation, to a certain extent, reduces the incentive for those organizations to go out and find external funding.

From the standpoint of industry, just a few comments. Relevance is probably the single most important issue from the standpoint of the private sector. When the private sector decides to fund activities at universities, they, I think, are more concerned about relevance than anything else. In many ways we are not particularly relevant, many times. We tend to be relatively inflexible in trying to become more relevant. For example, I think we have all seen many times what happens when an industrial company comes in, manages to make contact and they say here's what they want to do. One of the first reactions you tend to get from faculties is, oh, that's trivial, that's boring, you know, it's not really anything we would do here. Most of the time, that's true. When industrial companies come in and try to define what they want you to do, much of the time what they want you to do is not very interesting and probably not good for them. We have a different situation from where you go to the National Science Foundation and you tell the National Science Foundation what you think is exciting. Although there are some constraints, by-and-large, we are used to operating in an intellectual community which has very much the same values that we do. The Foundation tends to have much the same kinds of values that universities have and industrial companies don't. They don't really understand this process, so we can't work with them as we have worked with other funding agencies. The first thing you have to learn to do is express great enthusiasm for their useless project and then try to help them to redefine it in some way that's reasonably satisfying for both sides. That's a very ticklish and a very delicate process but you can do it. I think there's a lot of evidence now that that kind of redefinition does go on, and it will go on very successfully, but it involves very different kinds of training for faculty members. Faculty members always tend, in a first response, to tell the industrial company exactly what they think of their project, and that generally is the end of the conversation. So we have an educational role. If we don't think what the company wants to do is sensible, then we have an obligation to try to work with the company to see if there isn't a project that would be of benefit to both of us.

I think industry is concerned about cost benefits and about productivity. They don't think we pay graduate assistants too much, nor do they think we pay faculty too much. Universities are always arguing that they're so cheap. Industry should come do it here because our overhead rate's low and our salaries are low. That's not what anybody's worried about. They're worried about the productivity. What am I going to get if I spend 50 thousand dollars here? Do I really get as much as if I went and spent 50 thousand dollars in a private research company? Where do I get higher productivity? You're going to train five graduate students but they aren't going to do very much on my research project. So I think we do have to be concerned about productivity and I believe that's where research institutes can play a role. One thing research institutes

ought to be doing is really thinking hard about high levels of research productivity. In academic departments, I think we can continue to focus on our primary mission. But if you have a research institute, intellectual productivity becomes a major consideration.

A set of problems that are very difficult to solve are proprietary problems. Many private sector organizations, correctly or not, believe that they have a great deal of proprietary knowledge and that a relationship with a university may well compromise this knowledge. I'm sure you've all heard comments that the graduate students will come and they'll work on this project and then they'll go to work for our competitor. Why should we support that? We're very sensitive to that. In Houston, two of our major companies, Exxon and Shell, believe they are really leaders in exploration and production and they're extremely concerned about doing anything which would compromise their proprietary information in these areas. The problem exists across the board. I think these kinds of problems, of proprietary concerns, run throughout the private sector. I don't think that it's possible for a university to convince a private firm that you can really deal satisfactorily with the proprietary issues. I don't think we can. I think it's true that universities are very open places. To the extent the private sector does business with us, we will not protect their proprietary information. As many of you probably do, I go to a number of non-disclosure types of meetings related to computing. You get some announcement and within a day after the meeting, where we've all signed non-disclosure agreements, I hear all of my colleagues in local bars all over the United States, discussing the most intimate details of whatever they got at the non-disclosure arrangement. The computer companies all understand that. They never tell us anything that they don't want us to talk about in the bar. This process was understood. But I think we just have to say yes, you're right, we don't protect proprietary information very well and we need to find the areas where we can work on exciting and interesting problems where proprietary privileges or where proprietary information is not a primary concern. I don't think Shell Oil is ever going to let us in on the innermost details of their exploration processes. I think it's unreasonable to ask them to do so. We would indeed do an excellent job of disseminating that information to a variety of other places. So I sympathize with them. I agree with them and this means we have to find other areas. I think you can find a number of those areas and there're the places where we can probably perform the best.

We do have both, I think, an education and a research role. We sometimes think of cooperation with the private sector as entirely research. I don't think it is. I think a lot goes on in graduate education or in undergraduate education and that segment may increase. If, as many people expect, the lower birthrates of recent years result in a reduction of the number of people entering the work force in the '90's and if the large numbers of women who entered the work force appears now to have reached a stable point, we will probably have a modest labor shortage in the '90's. We know what the effect of a labor shortage is. A lot of people go from high school directly into jobs. They don't come to universities. We may see an increasing role for universities working with industrial companies to try to deal with the fact that those companies will have a number of people who are not very well educated, at a time in our society when education is going to be very important. So I think there's a big educational role. I won't go through all the various ways of cooperation between industries and universities and education, but I think that's very important. One day the very high quality universities that have tended to have little interest in training people from industry, may well change their views

over the next 15 or 20 years. My own institution has always depended very heavily on graduate students from local industry, and so this seems like a very natural approach to us. You have to change if you're going to deal with graduate students or undergraduates from industry. You make a number of changes in your traditional teaching programs, starting with scheduling and a variety of other things.

Let me go for a moment to discuss some research programs. There is a great deal of potential, as we have said, for research support from the private sector, but relevance is important. You have to convince them that what you're doing is relevant to them, and that you can be effective at it. That says you deal from strength. They generally don't go into a place that is very weak and say they'd like to carry out some research where they can build up a program; by and large we'll have to build programs up with federal government support or with our own internal funds. Unless we have a strong program, we probably can't seek industrial support. If we have strength the traditional project support route does not produce any internal problems. Thus, there's a lot of interest in going out on a project by project basis. No one really complains if a faculty member goes out to an industrial company and gets a research grant. We encourage that. Why? Because there's direct faculty control, so the faculty themselves don't get upset about this. But it's limited in scope. The problem is that in our current environment, it's an exceptionally high cost activity. In the government sector, we deal with a relatively small number of funding agencies and we deal with agencies that have a lot of expertise at distributing funds. That's generally true for foundations. Again, we understand each other at the government sector and we understand each other at the foundation sector. There isn't anything equivalent for most industrial companies. Even companies that have fairly sophisticated operations for dealing with the universities, have to be very decentralized when it comes to research grants. Consider IBM, for example, which we assume has a relatively sophisticated organization for dealing with universities. Nevertheless, every local organization of IBM may hand out monies for specific projects. It isn't like you're dealing with a thousand companies; it's more like you're dealing with ten thousand different groups because there are many pieces of companies that are handing out money for project support. So the big problem in project support is that there's very limited information on both sides. Faculty members don't know where to go. Industrial companies really get a very limited set of proposals. They don't really have any idea who's the best person or who's the best group or organization to carry this out. So we suffer from a real lack of any kind of an effective market. I think that's a major problem that we have to face. How do you develop an effective market in the industrial sector if you want private support at the research project level?

Now, institutes are one way out of that. You gather a group of companies together or you get one company to make a very large commitment and then you have a program going which greatly reduces research costs on both sides. Both sides benefit greatly because they don't spend all their time trying to get together. This mechanism which we call markets for bringing people together, doesn't exist and so people look for other kinds of alternatives to substitute for that kind of a market.

Research institutes are much more controversial because all the issues of control and of distortion of programs all come back in and generate excitement among faculties. So we don't have a totally satisfactory solution. I guess you could ask the question, is there a satisfactory solution? One thing you might

hope to see develop is groups of industrial companies and business firms getting together and setting up foundations that would then dispense money for research. You want something like the National Science Foundation where you have a professional staff, who know something and have an institutional memory. If an organization does a very bad job, you don't give them any more money and you give it to people who do indeed do a good job. You would like to see all those kinds of things exist in the private sector. They don't exist. There're some attempts to do it. But there also is a strong tendency in the private sector to move in a different direction, which is characterized by the recent event in Texas of the coming of the Microelectronics and Computer Corporation. Note that you've got a group of companies who did indeed get together and they also decided they were not going to do that primarily by funding university work. They were basically going to do that by creating their own new research institution and hiring a staff and becoming an independent operation. I would like to argue that widespread following of that model, I think, presents a major problem. It certainly dilutes the university role in basic research. I don't think that's good for society because societal needs change a great deal over time. One of the nice things about universities is, that universities have another role and another mission and they will continue over time. For example, when all the money dries up for solar power research, universities move on to something else. When you create a new independent organization, those organizations are very difficult to get rid of. Thus, they really cause problems of societal resource allocation. Once you create that organization, it's going to continue to get funds for a long time to come as the staff people depend on it. It develops its own existence. I would argue that society is much better served if instead of creating new institutions, industrial companies would band together and provide support to universities along the model of the National Science Foundation. You probably get higher intellectual productivity. Getting better results for the money you are spending is an important thing for society. Such a model appears to be a much more interestintg model. Now, that model was considered, I understand, in the case of MCC and was rejected. They decided to go in a different direction.

I think we have an educational job of convincing the private sector that putting together foundations that will support research at universities with large amounts of money is an effective way to carry out research in the United States. What is needed is not 100 thousand dollars a year, but really the kind of money that went into MCC. If we can do that, then I think we have created a viable market mechanism that really begins to make it possible to have a large amount of private sector support.

If I try to summarize all these ideas, I arrive at the following set. There's a very large potential out there. There's a lot of money available for research and development and that universities get a relatively small portion of it. We have not developed the kinds of mechanisms that will really allow universities to effectively compete for money from the private sector. I think we're not sensitive to relevance, and we don't have the right kind of market.

Universities will have to undergo some substantial change. I think you probably need first of all, a commitment on the part of the institution. I think it is difficult for, say, an individual faculty member in engineering to say, yes, I would like to have private sector support. I think you really need an institutional commitment that says the institution wants to have private support and that they are willing to make the necessary changes in the institution while protecting the academic values that they believe are most important. One obviously needs faculty support and we will probably have to change a lot of our policies and support services.

Industrial companies have different expectations. When you go to the National Science Foundation with something scribbled on the back of an envelope, they understand. We are all academics. When you go to an industrial company, they are used to very nifty presentations. They are not terribly impressed by someone who comes in and scribbles on the back of an envelope and says I have a great idea. We probably have to develop support systems that provide for the preparation of more classy and more elegant proposals if we want to compete in the private sector.

I guess for about 65 percent of the research universities or state institutions, the states by and large have not encouraged universities to do research at all, or to seek research support from the private sector. I think we probably need a major campaign to convince state legislators and the populace of individual states, that private sector support in research and activities in public universities is a desirable activity and one we ought to pursue. That will result in a whole series of changes. Those of us who operate in public systems get accustomed to the fact if you want to buy anything, it takes six months to a year to buy the simplest thing and then you have to buy from the lowest bidder who probably produces something you didn't want in the first place. You can't live with that. I know you can live with it somewhere but you certainly can't live with it in sponsored research. You can see a whole list of other things in state systems which are not set up to support research and they are certainly not set up to support research financed by the private sector. There will be a significant change in state institutions. I think that change is much easier in private institutions.

I will just in ending, emphasize again, I do not think that universities are well prepared today to seek support from the private sector. It does require a significant change, and it requires a significant commitment. If that happens, then I would believe universities will be very successful. Thank you.

SESSION VII

THE ROLE OF THE RDLP IN THE TECHNOLOGY ALLIANCE

MR. DUMMER: Session 7, "The Role of the Research and Development Limited Partnership in the Technology Alliance", will address a broad range of questions relating to those relatively new mechanisms for funding R&D. What are the characteristics of technology suitable for RDLP development? What options are available for disposition of the developed technology? Under what circumstances might a university itself instigate an RDLP in support of its own research? What circumstances favor a large partnership funding research at multiple institutions as opposed to small targeted ones funding a single technology at one institution? Should the university and/or investigators be limited partners and/or accept equity in companies started by the RDLP? What is the potential value of the RDLP as a funding mechanism to bring small and medium companies into cooperative research arrangements with universities? How can state and local economic development agencies encourage this? What risks do RDLP's create for a university and how can they be controlled? Our institutions may very well, in the next few years, be dealing with these and other questions.

It is now my pleasure to introduce your moderator, John Dearden, Director, University Sponsored Projects Office, Johns Hopkins University.

MR. DEARDEN: Thank you, George. Welcome and good afternoon. During the proceedings of this conference thus far, there has been relatively frequent reference made to Research and Development Limited Partnerships as actual or potential funding vehicles for university projects. Well, the time has come. Now, at last, you are going to find out what R&D Limited Partnerships are all about. Before we proceed, however, I wanted to exercise my prerogative as moderator and attempt to place this panel's topic within the overall context or focus of this conference.

Making the private sector/university alliance work, is a process problem within our national high technology system. In all likelihood, it is a serious problem whose solution is critical to our national economic well-being. The technology transfer process is the moving of discoveries from the university laboratory to practical application and the market. To date, this movement has typically been slow and difficult. Few universities are adept at identifying, developing, licensing or otherwise commercializing inventions, and the industrial sector has never exploited university based technology in a systematic and fruitful fashion. This is true to a high degree because most university based new technologies or inventions are not developed to the point that the factors of commercial viability or risk can be reasonably assessed. Few universities are willing or interested in, or even able to independently develop their intellectual products to that point, and few corporations can justify underwriting the costly process of development before that point is reached. Thus, a high risk, high cost gap exists which impedes the technology transfer process. Whether and where R&D Limited Partnerships can attenuate that impediment, in what manner, in what role and bringing what risks, is the topic of this panel.

The first speaker is Lee R. Petillon, who is a partner of Petillon, Murray & Dieterich, a law firm in California. Mr. Petillon has been a lawyer for 25 years and has been engaged in private practice since May 1978, primarily in the areas of business, corporations, securities, mergers, acquisitions and corporation finance. From 1971 to 1978, he was Vice President, General Counsel and

Director of Technology Service Corporation, a Santa Monica engineering radar studies firm. In addition to acting as legal counsel, he directed corporate development, external financing activities and mergers and acquisitions. From '70 to '71, he was Corporate Counsel to Harvest Industries, Incorporated, responsible for SEC reporting matters as well as mergers and acquisitions. From '69 to '70, he was an Officer of Creative Investment Capital, Incorporated, a Los Angeles based investment counseling firm, directing venture capital activities. From January 1968 to February 1969, he was a Director of venture capital activities for Cliner, Bell & Company, a Beverly Hills investment banking firm. From 1960 to 1967, he was Vice President, Treasurer, Assistant General Counsel and Director of Electronics Capital Corporation, a publicly held small business investment company based in San Diego and responsible for SDA and SEC regulatory matters as well as negotiating, preparing, and monitoring agreements for 25 million dollars worth of venture capital investments. During this time, he also was Legal Counsel for Republic Technology Fund, Incorporated, a 45 million dollar mutual fund responsible for SEC regulatory matters. As you can see from that, Lee has significant experience in high tech issues.

Lee will begin by describing typical structures and operational modalities of R&D Limited Partnerships and will then devote the larger part of his remarks to where in the high tech system and the technology transfer process, involving universities, R&D Limited Partnerships may naturally and appropriately be located.

MR. PETILLON: Thank you, John. My fellow panelists have, I think, the more difficult job than I do, but I still worry about whether I am getting across what I was charged with trying to convey. I usually talk about R&D Partnerships to patent lawyers and business lawyers. This is a new experience for me, and I hope that you won't talk about me like the two fellows did who were up in a balloon, lost in the clouds. They saw an opening in the clouds, saw the ground and tried to get lower. They saw a man on the ground and shouted down at him, "Hello, down there." He said, "Hello." They said, "Where are we?" He said, "You are up in a balloon." One of the fellows in the gondola said to the other, "You don't have to bother asking him any more questions--he's obviously a lawyer." The other fellow said, "Why do you say that?" He said, "Well, he told us exactly what we asked him, and we're no better off now than we were before." I hope I can do better than that.

There are basically two types of R&D Partnerships and perhaps, as a result of these two days of very interesting meetings, there may be some other types of R&D Partnerships that will involve university research. The two types of garden variety R&D Partnerships are: Royalty R&D Partnerships and Equity R&D Partnerships. Basically, the only difference, and we will get into this in a couple of minutes with a couple of graphs up on the board, is that in a Royalty R&D Partnership, the returns to the limited partner investors that put up the capital, are royalty income, whereas in an Equity R&D Partnership, the return is stock in a new corporation that is formed at the conclusion of the research and development activity. We will see this in some figures when we get a little bit further along.

I might just cover a brief history of R&D Partnerships following Les Misrock's excellent discussion this morning. As Les Misrock indicated Section 174 was adopted in the 1954 version of the Internal Revenue Code. Congress wanted to put small companies on the same footing as large companies in being able to write off their research and development activities. However, it was

not until 1974, when the Snow vs. Commissioner case, that Les alluded to, came down from the U.S. Supreme Court. This decision basically permitted partnerships to write off, at the beginning, these R&D expenditures and thus to permit the tax benefits that would provide the incentive for these partnerships being utilized as a financing vehicle.

Despite the fact that the Supreme Court gave this very favorable interpretation in 1974, it was not until 1977 that I saw any R&D Partnership used for this purpose. A little company in Florida called Concepts, Inc. used R&D Partnerships to finance new product development. The company's officers talked about this new financing vehicle before the New York Society of Security Analysts.

In California, they started to be used about 1979-80.Western Digital put together a two and a half million dollar product development and financed it through an R&D Partnership. The R&D was actually done, I believe, by Battelle Memorial Institute.

I am sure you have all heard of some of the larger R&D Partnerships. I guess the first large one was Storage Technology, in 1978, which raised $50 million. In 1979, Trilogy Computer Development Partners was the first publicly offered R&D Partnership, at $55 million. Merrill Lynch did that. Since then, Genentech raised $55 million. There have been some R&D Partnership pools funded in the last couple of years to invest in a number of different projects. One of the first, a $16 million dollar pool was formed in 1983. Prutech Fund raised $22 million last year. Prudential-Bache sponsored that fund. The latest R&D Partnership, closed a couple of weeks ago, is known as Hybritech Clinical Partners, a $70 million dollar R&D partnership.

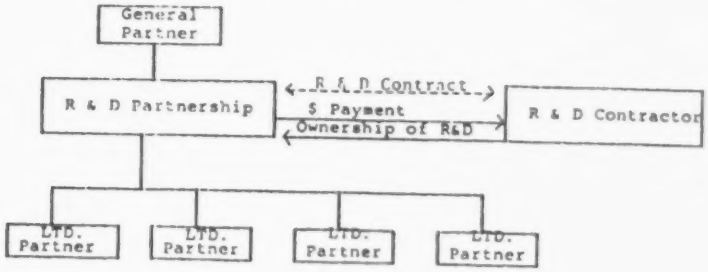
The typical structure of an R&D Partnership is shown in Table I. I think it is important to try to understand the relationships between the various parties because the relationships can get complicated down the line. The Partnership is the box on the left, and the General Partner can be either an individual or a corporation. The R&D Contractor, which is usually the company that sponsors the formation of the R&D Partnership, is the box on the right. The relationship between the R&D Partnership and the R&D Contractor is represented by the dotted line. That is a contractual relationship, the R&D contract. There are dollars being transmitted from the Partnership to the R&D Contractor. In exchange, the bottom line shows ownership of R&D in the Partnership. The ownership must reside with the partnership in order to secure the deduction, under Section 174 of the code. Section 174 requires the R&D work to be at the order of and at the risk of the partnership. The limited partners, represented by the lower boxes, are passive investors. They are usually high income people that can use the write offs.

Step one, as shown in Table I, is the organization of the Partnership. Step one includes the performance of the research and development portion, which usually takes between six months and a year and a half. One of the principal advantages of an R&D Partnership is to get a write off of a very large portion, usually around 85 percent, of the dollars invested. Why 85% instead of 100%? Well, usually there are some front end, organizational and syndication costs that have to be either amortized or capitalized, i.e. deducted from the proceeds. So usually about 85 cents out of every dollar that actually goes directly into R&D can be written off by the investors.

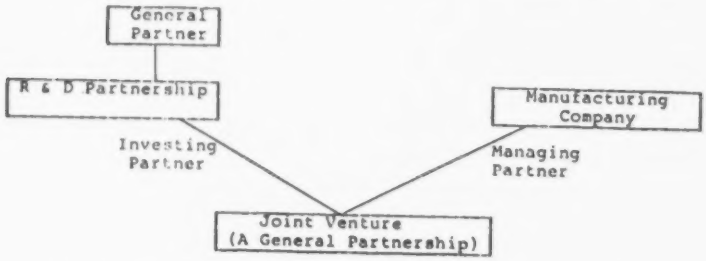
TABLE I

STRUCTURE OF A ROYALTY R & D PARTNERSHIP

Step 1 - Organization of R & D Partnership
- Performance of Research and Development Contract

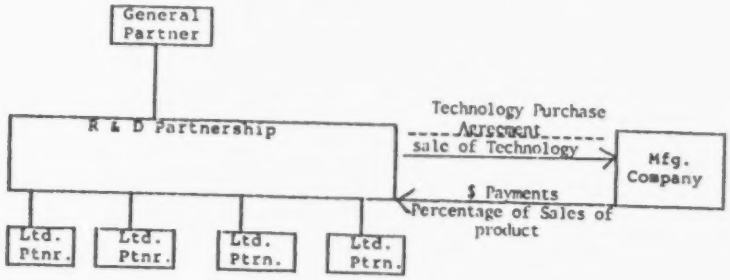


Step 2 - Joint Venture (or Non-Exclusive License) Between Manufacturing Company and R & D Partnership - 7 months



1. R & D Partnership constitutes License to use technology.
2. Manufacturing Company contributes some capital, License to use base techology, and manages it.
3. Profits are split, say 80% - 20% (80% to Manufacturing Company for first year, the 60% - 40% [60% to Manufacturing Company]).

Step 3 - Sale of Technology to Manufacturing Company:



Notes:

1. The General Partner may be a corporation or individual.
2. The R & D Contractor is the entity performing the R & D under contract with the R & D Partnership.
3. The Manufacturing Company is the firm which licenses the rights to manufacture and market the product. (The Manufacturing Company and the R & D Contractor are usually the same entity, and are referred to as the "Sponsoring Company".)
4. The General Partner, R & D Contractor and Manufacturing Company may be the same entity or related entities, subject to certain tax risks.

Step two, as shown on Table I is what I call the joint venture or non-exclusive license period. The joint venture is with a manufacturing company, usually the same company that is the R&D contractor. The manufacturing company enters into this joint venture to test out the product, or to start manufacture. Alternatively, this phase is accomplished by a non-exclusive license under which the manufacturing company evaluates the invention.

At the same time, a very important tax objective is being accomplished. That is the establishment of a holding period. The investors' end goal, after the deduction is taken, is to receive royalty income entitled to capital gains treatment, taxable at a maximum of 20 percent instead of the maximum ordinary income rate of 50 percent.

Well, I am sure a lot of you involved in licensing of patents are familiar with Section 1235, that gives statutory capital gains treatment on the complete sale, including an exclusive license, provided you don't have fields of use or other severe restrictions on the use of the patent. But there are some difficulties with 1235. You have to be a "holder", a defined term. There can't be substantial relationships between the partnership transferor and the manufacturing company, such as a 25 percent or more ownership of the corporation by the partners in the aggregate. So you rely on other sections of the code for capital gains treatment, namely Section 1231 and 1221, both of which require a holding period. That holding period, with the new Deficit Reduction Act of 1984, has been reduced from one year to six months.

The next step would be the sale of the technology to the manufacturing company. Here the partnership sells the technology to the manufacturing company in exchange for royalty payments that, if structured properly, should be entitled to capital gains tax treatment.

Table II shows the next type of R&D Partnership, an Equity R&D Partnership, which is different in a couple key particulars. You still have the general partner, but in this case, it's usually a corporate general partner, founded and owned by the inventor and other key members of management. It usually exists prior to the formation of the R&D Partnership. The R&D Partnership is the box on the right, with the same limited partner investors. The founders receive common stock in the corporate general partner, and the corporate investors, for example, example, a venture capital fund, usually receive convertible preferred stock. Partnership investors, of course, received limited partnership interests. The corporate general partner receives a general partner's interest in exchange for any preexisting technology transferred to the Partnership.

Step two is the incorporation of a new corporation, which I have called Newcorp, the box on the bottom. The shareholders of the corporate general partner transfer their shares in the corporate general partner to Newcorp in exchange for stock of Newcorp, and the limited partners transfer their limited partnership interests to Newcorp in exchange for Newcorp stock. This is a tax-free incorporation under Section 351 of the Internal Revenue Code.

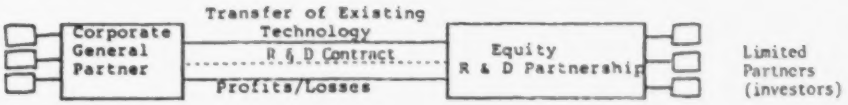
Step 3 shows the situation after the incorporation step. Newcorp is owned by two sets of shareholders, the former shareholders of the corporate general partner, and the former limited partners of the Partnership. The corporate general partner winds up wholly-owned by Newcorp.

TABLE II

STRUCTURE OF AN EQUITY R & D PARTNERSHIP

Step 1 - Organization of the Partnership and Performance of the R & D Contract:

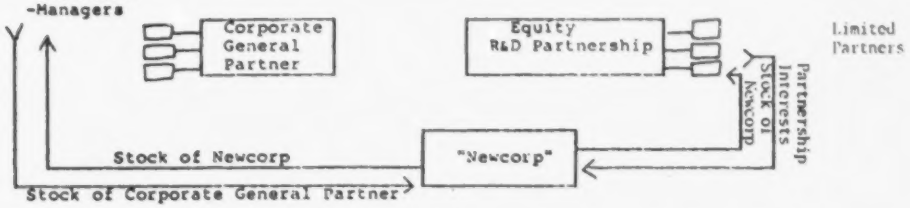
Shareholders:
-Founders
-Investors
-Managers



- Founders receive common stock in Corporate General Partner
  Corporate investors receive convertible preferred stock in Corporate General Partner
- Partnership investors receive Limited Partner Interest
- Corporate General Partner receives General Partner's interest in exchange for Existing Technology

Step 2 - Incorporation of Newcorp and Transfer of Partnership Interest:

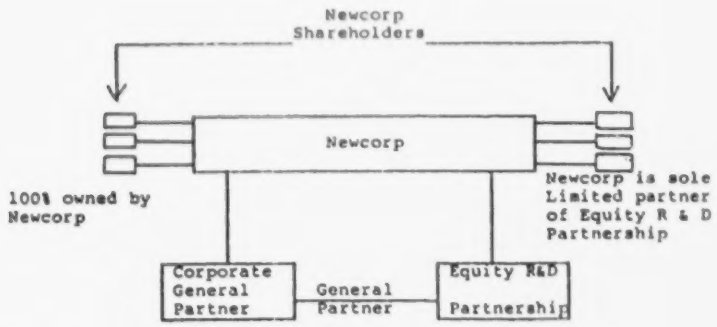
Shareholders:
-Founders
-Investors
-Managers



- Limited Partners transfer their Equity R & D Partnership Interests to Newcorp in exchange for Newcorp convertible preferred stock in tax-free exchange.

- The Shareholders of Corporate General Partner transfer their stock therein to Newcorp in exchange for Newcorp stock in tax-free exchange.

Step 3 - After Incorporation



- Former shareholders of Corporate General Partner are now common shareholders of Newcorp.

- Former Limited Partners of Equity R & D Partnership are now convertible preferred stockholders of Newcorp.

- Corporate General Partners and Equity R & D Partnership continues in existence (for at least two taxable years).

What are the advantages and disadvantages of R&D Partnerships? These are shown in Table III. The advantage to the sponsoring company is that it is an alternative way of raising capital as compared to conventional venture capital, bank borrowing or a private placement or public offering of stock. In a Royalty R&D Partnership, usually no equity is given up. In an Equity R&D Partnership, equity is given up, but usually less than in a conventional stock offering, because of the tax benefits to the investors.

The disadvantage to the sponsoring company is that because this is a somewhat complex transaction, the transaction costs are higher. The advantages to the partners are simply that they get a tax benefit and secondly, a benefit entitled to capital gain treatment: either stock in an Equity R&D Partnership or royalties in a Royalty R&D Partnership.

My co-panelists are going to be discussing some interesting concepts how an R&D Partnership can be used in a university research setting. I'll just suggest a couple, and I am sure they will explore a number of other alternatives. In one structure the university or a faculty member acts as the R&D contractor. In such a setting, the university licensing department could act as the negotiator and bring their expertise to bear to assist the faculty member in developing the R&D contract and any other arrangements down the line. Another possibility would be to use an R&D Partnership pool to finance university-sponsored research. Les Misrock discussed that in a very articulate way. I think we may see more cases where a university and a private group of capitalists put together an R&D partnership pool to fund a number of different projects, either with one university or a group of universities. Apparently that was the idea with one of the models Les Misrock mentioned this morning.

R&D Partnerships are certainly no panacea, and they are not a principal way to support research. I think basic research support still has to come from the government. But as universities become more aware of the process of unlocking inventions which are closer to the "D" stage than to the "R" stage, they will become more active in the development and commercial exploitation of these inventions. Perhaps the R&D Partnership can be a useful tool in this process. Thank you very much.

MR. DEARDEN: Thank you, Lee.

Our next speaker is Clifford E. McClain, who is President of the SPC Venture Corporation. Clifford is an MIT graduate in Aerospace Engineering whose career, over a period of 30 years, has included R&D activities in the military and civilian government agencies and in the private sector. Among his more recent accomplishments, Cliff is Vice President for Corporate Development of System Planning Corporation, with responsibilities for commercial products and joint ventures. He is President of SPC Venture Corporation, President of Accumetrics Corporation, President of Severin Financial Corp., which is a managing partner of an R&D Partnership, President of Year of the Ocean Foundation, and Chairman of the Board of LZS Publications. He is on the Board of Directors of Entech Corporation.

Cliff will discuss the use of the R&D Limited Partnership as one weapon in the arsenal of techniques to stimulate local or regional economic development in the context of university involvement.

TABLE III

ADVANTAGES AND DISADVANTAGES OF

R & D PARTNERSHIPS

ADVANTAGES TO COMPANY:

1. No equity dilution
2. Financing off P & L and balance sheet
3. Retention of control
4. Second round financing
   - No previous equity dilution
   - Company in better barganing position
   - Less risk to second round investors
5. Company offers less capital appreciation (as trade-off for tax benefits)

DISADVANTAGES TO COMPANY:

1. Transaction costs are high
2. Funds can only be used for R & D (no marketing or general working capital)
3. Royalty payments must be made irrespective of profits

ADVANTAGES TO LIMITED PARTNER/INVESTORS:

1. Immediate R & D Deductions
2. Royalty return not dependent on company profits or stock market
3. Earlier return on investment
4. Possible capital gains on royalty income
5. Investor doesn't share in company's other business risks
6. Returns not "bunched" in one year, as in sale of equity

DISADVANTAGES TO INVESTORS:

1. High risk - creative stage of development
2. Substantial risk that product, even if developed, can be successfully produced and marketed
3. Risk of technological obsolescence
4. Competition from established companies
5. Tax benefits may not materialize - few tax precedents

S CORPORATION ALTERNATIVE:

1. Limited to 35 investors (no corporate or partnership shareholders)
2. Only one class of stock (but can have different voting rights)
3. No special allocation of deductions similar to partnerships
4. 1235 Capital gain probably not available

MR. MCCLAIN: Thank you. Well, it is a great pleasure to be here and I have certainly enjoyed listening to all the many ideas that have been brought up in this conference. The particular thing that has interested me is that universities, colleges, and academia in general offer a set of useful assets to a state, regional or local area that is considering problems that it may face on its own, I'll call it, socio-economic environment that it wants to do something about. We have been looking into ways in which universities, with partial support from other sources such as R&D syndications, for example, can provide a key to addressing these kinds of issues.

I thought I would make just a couple of quick observations before plowing ahead with this subject. One is that when looking into the ways wherein these kinds of programs might fit within universities, I think it is very important to keep in mind that, whatever the environment of the university is, such involvements must fit within the academic objectives of the university. That is to say that the things that the university exists to do have to be the things that are supported by the activities that we are talking about. Return on investment is the key issue with respect to whether a given project is a reasonable thing for private capital to do or not. Those academic objectives which attract private sector investment are obviously going to be ones that emphasize applied technology. Such objectives may fit better in some areas of the school than in others. I like to think of it as an opportunity for the expansion of academic opportunities for students and faculty in the applied research and engineering fields. It is important to note that, if the private sector is going to be involved and if in particular we are going to use such things as R&D syndications, the benefits of return derive from success in the marketplace. If the products actually don't reach the market and are not sold, there is nothing with which to provide the return on investment, either through royalties or through the value of stock in an equity arrangement. So the developments must be applied and practical.

The second is that it has been my observation, in talking with a number of universities and schools, that one of the areas that seems best suited to this kind of a consideration, is that provided by medical schools and medical centers associated with universities. I think the reason for this is that medical schools and centers have inherent in their own operation the practical application to clinical practice in associated operating hospitals and internships. I found that there is a very strong feeling of practicality in such organizations for developments that actually make sense in an operating environment. In fact, they constitute the first trial market for their own inventions.

Finally, various kinds of funding organizations, and I am going to talk about the use of an R&D Limited Partnership as a potential financial source, can serve as a mechanism for risk spreading, which is a very important element in encouraging investment in higher risk areas. Furthermore, from the standpoint of colleges and universities, R&D Limited Partnerships do provide an additional path to new sources of funds, but not the only path and not the only solution.

I would like to refer briefly to Figure 1 which summarizes some of the structure that Lee was talking about. I have used a structure occasionally shown by Dr. Bruce Merrifield, Asst. Secretary of Commerce for Productivity, Technology, and Innovation. You see the university represented by some kind of a research center that it has established. It doesn't have to be a formal organization, but in any event, it is a mechanism for carrying out research activities. I have merely shown a number of lines to indicate that these activities and their

INSTITUTIONAL RESEARCH CENTER WITH TRIPARTITE SUPPORT – A PROPOSED MODEL

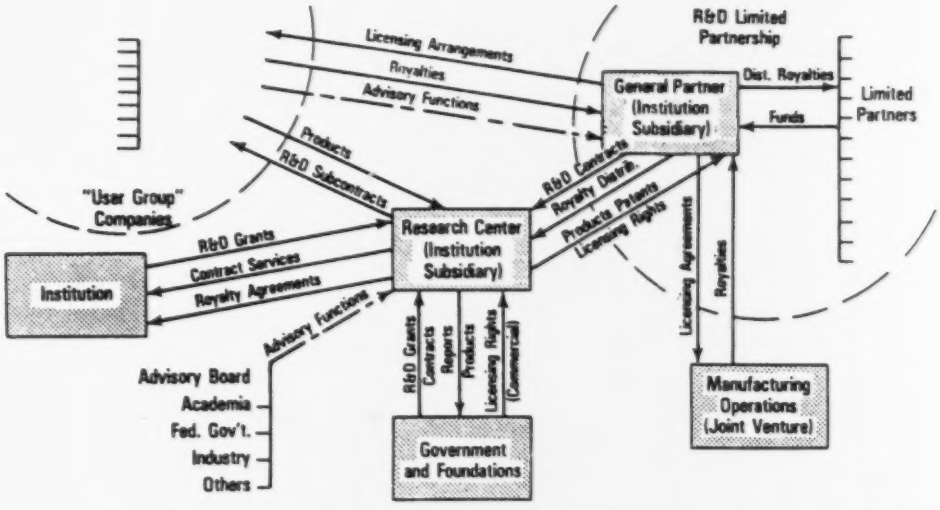


Figure 1

PARTNER CONTRIBUTIONS

• University	R&D and prototype demonstration Innovative education Demonstration of effectiveness University faculty and facility resources
• Government	Grants and contracts for: R&D "Model" demonstration center Education and training Improved cost effectiveness
• Private Sector	Venture capital funds Translation from R&D to marketplace Uses basic support to provide "leverage" for private sector investment

Figure 2

interconnections with private enterprise are supported by a series of licensing and royalty arrangements. Tripartite support is suggested from institutional, government, and industry sources. What I am suggesting here is that there are a number of sources from the outside to which such an academic research capability can respond. These include some of the traditional sources from the government. Another is a source of support from various advisory groups. From the private sector, a syndication can provide an additional source of support and it may actually be effective over a very long term. Companies can be established by the private syndication or a set of companies that I call user companies can be organized. These are companies which can manufacture and sell products that are derived from the technology developed by the university research center and who are licensed to do so either by the general partners or by the university. In any event, the context in which I would like to discuss these ideas for a few moments with you is that of a partnership between the private sector, academia, and government under which such research center projects might act in such a way as to promote regional, local or state wide economic development. I will present three examples of what might happen, all of which are derived from current experiences in which we are engaged.

First, let us consider what the partnership contributions may be from each participating organization. These are shown on Figure 2. Obviously the university provides a storehouse of technological capability, and I am referring to technology in all areas. We tend to emphasize the physical sciences, but actually there are areas associated with education, government, and other subjects from which marketable products might be developed. The government offers an environment of policy and law under which such developments can take place. One of the key things government can supply is a series of "rules for the game" of investment, which hopefully will stay constant during the course of activity. Government can also be a source of grants and R&D contracts to the center. State and local governments can often provide the context of a plan in which development might take place. The private sector provides the bulk of the financial muscle for getting these projects done. The private sector also provides the actual operational systems for the manufacture and sale of products and the technology and investment base for building a new or changed economic base.

In Figure 3 I would like to briefly suggest the kind of structure that can act to address such a partnership development activity. I will review some of these in particular. You see on the left side of the Figure the assets from which you might develop some new economic base, and which would assist in strengthening the economy within a state or region. There are also illustrated a number of financial asset sources that might be brought to bear to accomplish the plan. Of course, the structure would be designed to address a set of economic goals and objectives under an area economic plan. We have been looking at this is the context of state plans to achieve a new economic balance or an improved economic picture for some region or locality within the state or perhaps within the whole state.

One typical example is that situation in which a region of the state has basically a one product economy. When economic times are such that the market for that particular product fails then the unemployment situation and the whole economic picture for the inhabitants and work force of that region is severely depressed, even in comparison with, let's say, a general economic malaise. We have just been coming through such times in the 1980, '81, '82 period. We have

PRIVATE INVESTMENT
AS A CATALYST FOR AREA ECONOMIC DEVELOPMENT

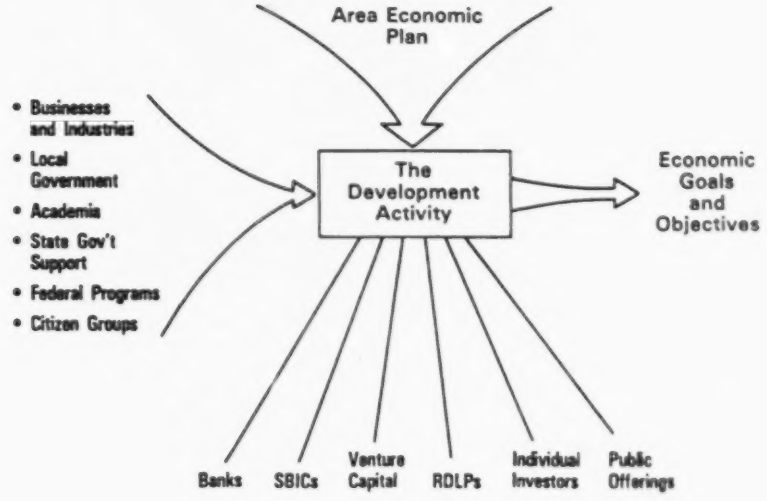


Figure 3

EXAMPLE STRUCTURES

1. SUPPORT OF A UNIVERSITY ASSOCIATED TECHNOLOGY PARK

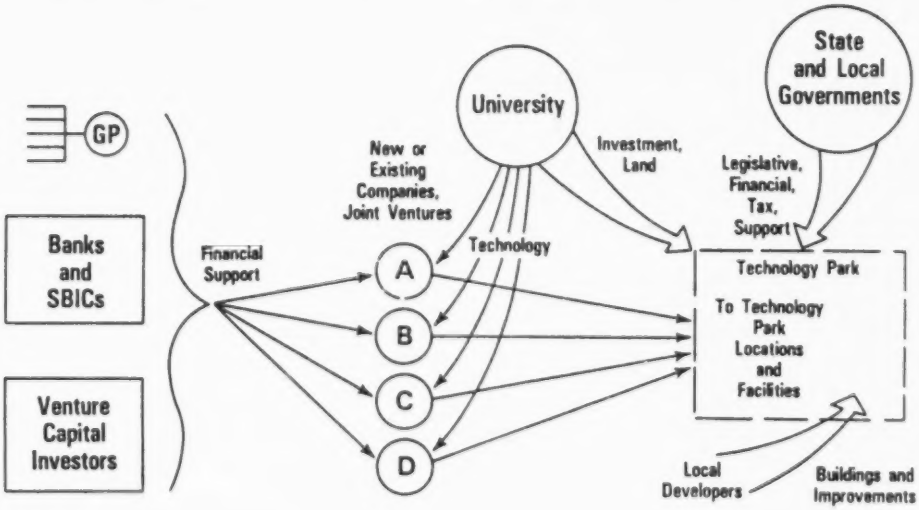


Figure 4

been working, for example, with the governor's economic counsel in one state in developing such a plan whereby the very limited economic opportunities within a region of that state might be expanded. We have suggested a structure in which the state university would play a key role in that development.

In another situation, a region within a state has seen a changing economic basis because much of their economy was based on second level manufacturing and supply operations which serve a major industry which is itself undergoing change. Bruce Merrifield talks about the change in the basic structure of "smoke stack America". Well, it's not only the people that have smoke stacks that are affected, but also those that are supplying services and secondary support to that major smoke stack operation.

Figure 4 illustrates the first of three example structures that I would like to briefly discuss. This first one suggests the support of a university associated technology park. I know many of you at this conference either have such a park going or are considering forming one. The thought is that if we put such a park in place, it's going to attract new high technology business. I know my home state of Virginia is thinking about this. It will provide a new basis for business growth. Furthermore, it will be a logical outlet for the technology that exists within the university. When we look at some of these plans, often we see that there's a very nice plan for real estate development. There is a vigorous plan for building buildings, but often there doesn't seem to be of a very specific plan for actually establishing organizations that will occupy the park or bringing people who will be a direct transfer point for the technology that exists within the university. We are suggesting that what is needed is that, in cooperation with the financial community and using all sources, including partnerships as a source of funding, a series of organizations be encouraged in this park which would derive from the supporting university. Yesterday, we heard a speaker from Lehigh describe just this kind of development. It's also occurring elsewhere. This kind of development can certainly be well tied in to a local and regional planning effort to develop new business space.

My second example, Figure 5, is the development of a new technology base which suggests that a consortium of industries or companies could work both with private capital, in this particular case an R&D Limited Partnership which provides pool funding, and with state development funds. We heard a description, for example, of the Ben Franklin Partnership in Pennsylvania. This is the kind of a structure that would foster such a relationship. Such a structure is another industry/technology building activity that could be a part of a regional development plan, and incorporte the development assets of a group of area universities.

My final illustration, Figure 6, is a two phase development which requires, in its first phase, the development of a basic technology in which the initial investors have an interest and then that is translated later in a second phase to a growing industry. In one case in particular, we are suggesting that this structure be applied where some additional fundamental research is necessary. What we hope to establish is a structure, supported by the state and by the initial private sector investors in this technology, that is capable of sustaining a long range view. Over a three to five year period the technology would be developed so it can then be licensed to a developing industry.

EXAMPLE STRUCTURES

2. CREATION OF A NEW HI TECH ECONOMIC BASE

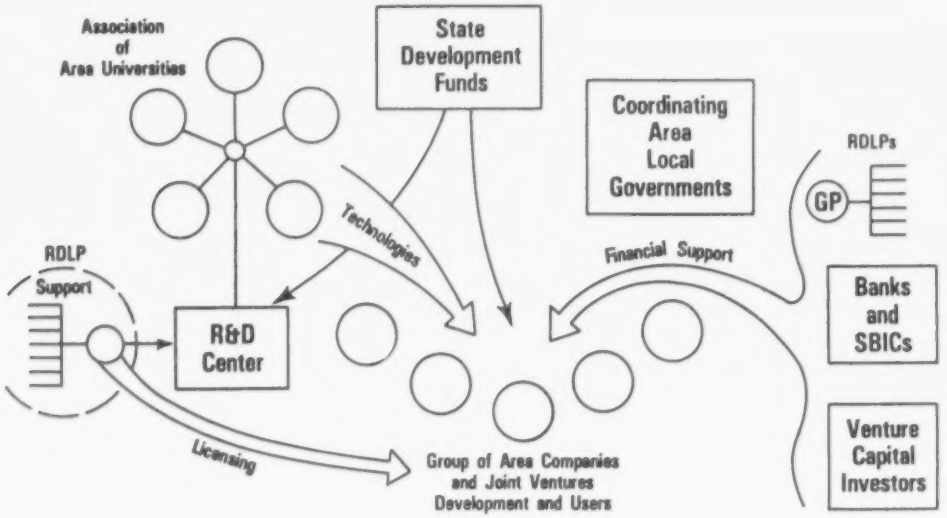


Figure 5

EXAMPLE STRUCTURES

3. SUPPORT OF A NEW ECONOMIC SECTOR DEVELOPMENT

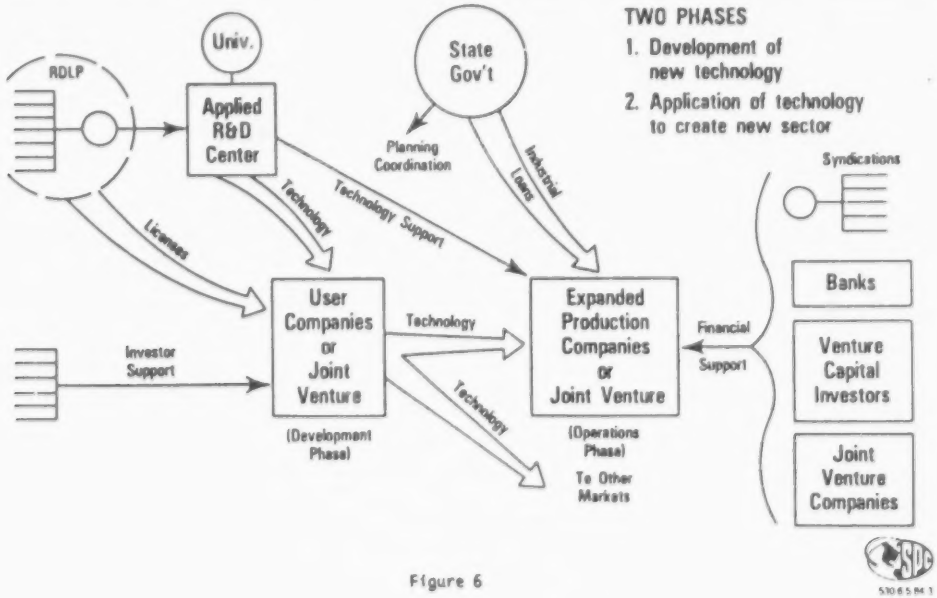


Figure 6

What I hoped to suggest by these brief examples, is that one of the ways in which we can look at the overall support of research and development in the universities, is to coordinate that support and make it part of a state, local or regional economic development plan, which in turn should engender a strong interest in local, state or regional investment. After all, the investors are investing in the development of their own assets, as it were. In addition, such support operates under the umbrella of a state, regional and local policy for the encouragement of this kind of business development. We think that is a strong incentive for private investment to enter into the partnership. Thank you.

MR. DEARDEN: Thank you Cliff. That was very interesting.

Our next panelist is Richard Schneider, Executive Officer of the College of Marine Studies, University of Delaware. Before coming to the University of Delaware, Rich was a member of the faculty of the U. S. Coast Guard Academy and was later Assistant Dean of Academics for the Academy. Rich holds a BS in Marine Engineering as well as a Masters in Physics and is a Ph.D. candidate specializing in the public policy of science. At the University of Delaware, he has administrative responsibility for all research grants and contracts at the College of Marine Studies. Rich is Director of the Lewis campus of the University, which is the site of a new university research park. Rich has been instrumental in the creation of an RDLP for funding research at Delaware and will discuss the R&D Limited Partnership from the perspective of the recipient university. Rich.

MR. SCHNEIDER: As a traditional academic, I only speak in 50 minute blocks. So this is a challenge. For those of you that don't know, the University of Delaware is a private, tax assisted corporation. It is not a public institution, and for that reason, we have some of that great flexibility that Dr. Van Horn alluded to at lunch. For those of you that don't know where Delaware is, it's a suburb of Washington and New York City. For those of you that would like to learn a little bit more about Delaware, I'll point you to the December, 1983, issue of Reader's Digest, and a very fine article entitled, "The Little State That Could and Did." In that article, it states that, "Delaware is one of four states in the union that over the last four years, has ended up with a budget surplus." I will leave it to the students in the group to identify the other three states.

I would like to know exactly where you are as students. I would like to see a show of hands, please, of how many of you have been actively involved in the establishment of a limited partnership for R&D? (Whereupon a few hands were raised.) Great. For the most part then, I probably know more than most of you. I am going to get very focused now. For those of you who represent universities, how many of you have ever been involved with the establishment or working with a Limited R&D Partnership? (Whereupon approximately 3 hands were raised.) There will be some homework assignments before the next time that we meet together at a workshop. I would like to review some features of Limited R&D Partnerships for those of you that know very little about them. If you would like to give me your business card, I would be happy to send you a short bibliography of essential readings which I will briefly review. In the March, 1984, issue of Venture Magazine appeared an article entitled, "University Research That's For Sale." I am happy to announce that the University of Delaware was mentioned in that article. If you want to know how venture capitalists think, see Time Magazine, January 23, 1984. The article is entitled, "Cashing in Big, With The Men Who Make the Killings." For those of you who want to know "how to do it" there is a

publication printed by the Department of Commerce in March. It's entitled "Information and Steps Necessary to Form R&D Limited Partnerships." It even gives you sample agreements in the back. If you would like to know a bit more about what RPI is doing there was in Forbes, December 19, 1983, on page 82, an article entitled, "University as Venture Capitalists." I knew absolutely nothing about taxes other than the fact that I had to pay them. If you would like to know more about what the difference between what a short term and long term capital gains is, other than talking to your tax attorney NSF put out a publication known as PRA Report, No. 83-7, April, 1983, entitled, "An Early Assessment of Three R&D Tax Incentives Provided by the Economic Recovery Tax Act of 1981." You do not have to be a lawyer to understand this publication. Another publication entitled "Tax Policy and Investment Innovation" was very helpful to me for understanding some of the things that drive investors. Last, I know Cliff mentioned research parks and that kind of raises the hair on the back of my neck. There are things to do and things not to do in establishing research parks. I wish I had read this one before Delaware launched ours. NSF put out a publication dated November 4, 1983, entitled "Geographers Find Complex Patterns in Location of High Tech Plants." Just the fact that you have a very fine academic institution does not guarantee success to your research park. As for the homework for the next conference, I expect that you will read and carefully outline these references.

Now, in the remaining time I will give you a short introduction which will be somewhat philosophical, not too philosophical I hope, and then I will issue some warnings to universities and, hopefully, indicate what Limited R&D Partnerships offer to universities and what the role they can play.

As regrettable as the decline in federal support may be, it has the virtue of pushing all of us concerned with support of university research to exercise some ingenuity and entrepreneurship, which in easier times might have failed, and in fact did. Indeed, to the extent that we succeed in creating the "right kinds of new ways" to obtain funds from the private sector for research, we should be ahead of the game when the feds come back into the market. What do I mean by the "right kinds of new ways" to obtain private funds? I don't believe that we have to rely on the instincts of saying that charitable contributions are for the public good. We can't rely on the support of academia out of the sheer goodness of people's hearts. That desire, as laudable as it is, seems to wax and wane with the state of the economy and with the perception of need, which is also dependent upon the level of federal support. The basic private support, which depends on the perception of real gain to the sponsor and to the university, to me at least, should be more stable and dependable. The challenge lies in structuring the arrangement which provides funding without requiring the university to compromise fundamental principals.

In the past, universities anticipated receiving financial incentives through normal patent licensing arrangements. We have heard a couple of people speak about that already. But the payout is sometimes low, if it comes at all. This is where you participate again. I would like to know how many of you are happy with the rate of return on your investment to university funds on your royalties and licensing of patents. (Whereupon a few hands were raised.) The four of you are to be commended. So the rest of us are all very unhappy with that, aren't we? Using our research limited partnerships as a vehicle for exploiting patents, which universities own, has promise and problems. For the latter reason, it's really a lawyer's delight, but they can be made to work.

Collectively, as universities, we represent the most sophisticated research resource in the world. The concept that our end products from our researchers are for the good of society, I think, is universally accepted. However, we always have displayed caution in avoiding commercial entanglements which would compromise academic values. The quest for profit cannot be allowed to shape the university's research agenda or influence the faculty appointment process. The needs of commercial users of university research for secrecy must yield to the academic imperative for openness. We heard some discussion on that at lunch. The university must insure that the technology it makes available to others for profit is used responsibly and services the goals that I mentioned before. At the same time, the university must insure that its name or reputation does not become commercial coin. Now, this point is not a point of snobbery and it is not an effort to avoid product liability. The commercialization of the American research university will erode the authority of our scholars as objective commentators of the truth. Now, we are not novices to the business of commercialization of our research findings, but there is, as you have all indicated, growing dissatisfaction in our rate of return of investment. This approach is safest for universities--to continue what we are doing now; just go ahead and license. We avoid entanglements, but it has some limitations from the perspective of the industrial partner. By our very nature, we are performing research which is far from the point at marketing.In most of our activity it is difficult to determine perceived commercial potential. It is for that reason that there is unwillingness on the part of the financial community to invest in them.

So what is it that the R&D Limited Partnerships offers universities? First, it offers an opportunity to determine the commercial potential of our technology, and it gives us the possible opportunity to share substantially in the profits of any product successfully developed. There are advantages to business as we have heard before. It is only an investment vehicle for venture capitalists. It is a device used by ongoing businesses to finance R&D without touching any of their own funds. They get somebody else to pay. For that reason, it is "off balance sheet funding". You can pursue the commercial potential of an idea, with the ability to decide at a later time whether to make it, or to sell it, if the idea proves out. It is a creature of tax law and it is an attempt to attract more capital to R&D.

The players you have heard mentioned. I do not recommend that a university become a general partner, although that is being explored. The general partner basically contributes the technology management skills required; the limited partners, supply the cash. Where are we in this whole mess? First, I mentioned we shouldn't be the general partner. I think participation by a non-profit in management of a venture designed to share in the net profits is incompatible with our charitable purpose for which we were granted the tax exempt status. That's personal opinion. Could we be a limited partner? Yes, we could be a limited partner through trust endowment funds, however, we can't take advantage of the tax benefit. Besides, most universities use very conservative investment management of the portfolio. We basically can license our patents through the general partner and we can do contract research. All these roles are pretty straight forward; we have done them before.

There are a few models, however, that should be discussed. As a university, you hold the rights to certain property. You can pool all of those technologies together and you can contribute them to a single R&D Partnership. You can break those technologies into relative disciplines or interest areas and go with specific limited R&D Partnerships for each cluster of disciplines. If you have one

that's very close to marketability, you can go to a single R&D Partnership for a single technology or invention. At Delaware we started with the latter case. We had a specific instrument which we wanted to get to market. We had established a Limited R&D Partnership through some friends of the University of Delaware. We are now exploring grouping technologies in the university. We can contribute technologies to the Limited R&D Partnerships. In return, we can continue to get royalties or we can have an equity position. I prefer an equity position. I would like to have the university get part of the action. I think that we can provide good input in that way. I agree with Walt Channing in that regard.

Whether universities become an equity holder or a licensor, it must enter into a web of understanding to protect its interest. For those of you that are taking notes, this is an important point. The contract should, among other things, specify the march in rights required upon the transfer of the rights to any technology developed under federal funding and it might be specified that there are severe standards of performance. You should establish reporting requirements of the general partner. These are mistakes that Delaware learned, by the way. You should establish arbitration procedures. If the university is to do contract work for the general partner, you must insure that the Limited R&D Partnership treats the university at arms length in its dealings with the faculty. You must place a limit on use of the university's name.

Limited R&D Partnerships are not a panacea to improving technology to transfer, nor are they a guarantee of providing a great amount of infusion of new research funds. However, they are worthy of your close and careful scrutiny. Thank you.

MR. DEARDEN: Thank you, Rich.

Our next and final speaker on the panel is L. William (Bill) Miles, who is Chairman and Chief Executive Officer of University Patents, Inc. Bill received a BA in Economics from Gettysburg College and an MS in Management Science from MIT. He is currently Chairman and CEO of University Patents, Chairman of University Genetics Company, and Chairman of the University Optical Products Company. In addition to that, he is Chairman of the Board of Trustees at Fairfield University, a Trustee at the Center for Financial Studies, and a Director of the Dorsy Corporation, the Bouton Corporation and Anton Medical Systems Corporation. UPI and its subsidiary companies have done four tax advantage R&D programs to date and have a fifth underway, so Bill has some direct personal experience in what he is going to speak on. His presentation will deal with potential problems and pitfalls associated with RDLPs.

MR. MILES: Thank you, John. When Tony Merritt asked me to speak at this meeting several months ago, I, of course, accepted since Tony is a valued client. I said, however, when he talked about the subject, that I knew at least a dozen people who were more proficient in speaking on the subject than me. And he said, yes, he knew that too and he'd attempted to get them but none would come. That left me. When we laid out the arrangement of speakers and I wound up fourth, I said to John, "That's terrific, that makes me the cleanup hitter." He said, "No, that makes you the last speaker." The last speaker speaks when everything else has been covered and there's very little time to talk about anything else.

The title that I picked for my presentation really was "Life After Research and Development Limited Partnerships". An alternative title might be,"There Isn't Any Free Lunch". I have heard a great deal and I am sure you all have heard a great deal, about the university utilization of Research and Development Limited Partnership, implying that seeking access to this kind of capital is appropriate for research universities.

I think the first thing I would like to ask you to do would be to think about a Research and Development Limited Partnership in a somewhat different way than you perhaps thought about it based on the legal definitions and so forth that you have heard. I want to thank Pat Cloherty because I think she set a very nice stage for the way I would like you to think. My definition, from a business point of view, of a Research and Development Limited Partnership is really quite simple. It is a tax advantage venture capital arrangement where the net investment that the investor makes after his tax deductions, should yield to him three to six times the return that he could receive in government securities. Let's not think of it as a separate kind of organism, it really is venture capital. Therefore, the investor is looking for at least the same yield that he would get if it were traditional venture capital. The only difference being that he's got a tax advantage in this situation.

The other primary difference, for universities in particular, we ought to think about is that, instead of venture capitalists who are institutional investors for the most part, in this situation we are dealing with the public. The reason we are dealing with the public is, that it's usually the public that looks for these kinds of tax advantages. Institutions typically do not look for tax advantaged investments.

There are two extreme ways that a university might conceive of being involved in tax advantaged venture capital. Model one would be where the deal originates at the university's instigation. Let's talk about what that means. The offering documents would be prepared at the university's expense. I can tell you that the price for that would be a minimum of about $100,000 and maybe as much as a quarter of a million dollars. That's pure risk investment, because the deal hasn't sold yet. The second thing is that there needs to be a management team, since we are not just doing research but hopefully we will have a product to be commercialized. The management team has to be recruited and presumably would be recruited by the university in this case, since it's the moving force. The third thing that has to be accomplished is the selling of the units to the limited partners. Now, generally there would be some kind of an intermediary involved in that, a brokerage house or somebody else. However, the university is going to be involved in that selling effort while perhaps not directly, certainly very heavily indirectly, because brokerage houses or accountants don't necessarily know how to sell this kind of technology deal. Further, the university or a surrogate of the university may have to act as general partner, if the university is the moving force behind the venture.

I get the feeling that perhaps without having thought things all the way through, this model is assumed to be appropriate. In my opinion, it isn't. As a matter of fact, I think it's very, very risky for the university, and it should be avoided like the Bubonic plague. Let me just give some reasons why I think it should be avoided. To the investor, the research and development phase of the limited partnership is the beginning, not the end. He's making a venture capital investment that you've sold him. He will look to you for a long time to make it all work, and he'll look to you for commercialization. I don't have to

tell you that everybody may not agree on just what success is. Also, keep in mind you are dealing with the public whose principal benefit initially is very up-front. They are looking for tax advantages. They are probably looking for them in a leveraged way, so that there will be a tax benefit in the current year. In fact though, they will probably be paying the bill for some time to come. Typically, for example, what happens is, an investor puts say $10,000 up in cash, and borrows $90,000 of a $100,000 unit. If that money is spent within the 12-month tax period--let's say we start in January and by December we spent the money--then the investor will have a write-off of $100,000 for a $10,000 initial investment. Of course he will still owe the bank $90,000. He's going to have to make those payments in the future. He can get very disagreeable if, at the end of the 12-month period, the research turns sour and he's still got a $90,000 bill, plus interest to pay, or if the research worked out well but he's not seeing anything happen about commercializing that research.

There was some talk about royalties as an investor repayment model. I can tell you that the IRS doesn't necessarily look at the royalty model as justifying a research and development write-off. Their position, at least initially, is that the collection of a royalty is not necessarily a continuing business. In essence, their position is that, if the limited partners put the money up, the university does the research and then the partnership sells the rights to that research immediately to somebody else for a royalty, and there is only a royalty left to be collected, there is a serious questions whether that represents a continuing business interest. What is now being done in other research and development limited partnerships is that, instead of royalties, joint ventures, are formed and the partnership take an active participation in the management of a business that uses the R&D.

To the IRS, the selling of Research and Development Limited Partnership, is also the beginning, not the end. You have to be prepared to deal with considerable debate over what frequently is an extended period of time with the IRS. You perhaps deal with great anxiety and maybe even anger from the partners who, although they may have been told going in what the risks were, are now frightened by the IRS and are looking to you as a general partner and the people who organized this thing, for relief and comfort which you are, I might add, probably unable to provide.

In your capacity as a general partner, the selling of the research and development limited partnership is the beginning not the end. Your legal staff will comment on your fiduciary responsibilities and problems. On behalf of the limited partners, you are assuming some of the same responsibilities as a general partner that a venture capital firm assumes when it makes an investment, i.e. you're going to assist in evaluating management and replacing it, if necessary. You're going to have to deal with the questions that come up inevitably about the second phase financing and all the rest of the ongoing business relationships that the Research and Development Limited Partnership just starts, it doesn't finish. On top of all of that, you are going to have to balance conflicts as both the spender of the R&D funds, versus the partner's long-term objectives and all of the public trust considerations that a university has to deal with on a day-to-day basis. In short, where the university takes that active an interest in the Research and Development Limited Partnership, I think the potential for damage to the university's reputation and perhaps pocketbook, are extremely high.

Another alternative has the university playing a passive role. That's essentially accepting a contract from a partnership to do R&D. Even in this situation, I think there is care that needs to be exercised. One item that's already been mentioned is the misuse of the university's name in the selling effort to get the limited partner's money. I've seen some of these arrangements. You can have all of the agreements you want, but if the wrong salesman hits the street, I guarantee that the university's name, if you're going to do the research, will be mentioned. Of course, you still have all of the usual problems with respect to property rights and who's going to get what, except that in this situation you are going to find that they are a little more complex.

You have to remember, even when you are a passive participant, that you are still indirectly involved with the public who may look to you, even though they shouldn't, for answers in the case of failure, and I don't mean necessarily R&D failures. Remember, it is the commercial endeavor that the limited partner is counting on to provide his investment return, plus a profit. What's the best solution? I think the best solution is not to go drectly to the market yourselves, because of the risks that I see. Further, I think you should thoroughly check out any intermediary with whom you might be dealing, even as a passive doer of research. Walter Channing mentioned the same caution in venture capital. There really is no difference here, except that here you have the added problems of dealing with the public.

The other caution is to make sure that you do everything possible to avoid involvement in the sale of units. Take every action that any prudent man can take to make sure you are not part of the selling group and get as much insulation between you and the public as you can possibly get, because I can tell you that these can be very difficult people to deal with.

Thank you.

MR. DEARDEN: I hope it hasn't discouraged everyone from investigating this concept a little further.

I've received a number of questions here, and the one right on top of the heap, indicates to me that we have a very slow person out there. It's directed to Don Langenberg, one of yesterday's panelists. The individual wants to know what are the names of the 62 universities still in existence? We'll let Don have 15 minutes to compile that list.

The next question is a little more serious. It is directed to Lee and it's really in two parts. One, "Have there been any challenges to the taxable tax treatment on the investment of the limited partners and if so, what are they?" Two "What liability might the university have if no marketable technology results from the R&D? Are you aware of any claims by limited partners against the university?"

MR. PETILLON: As to the first question: One of the problems of using R&D partnerships is that there is a paucity of reported tax decisions. It's a largely uncharted area. That's good news and bad news, actually. The only reported area that I've been aware of recently is a private IRS letter ruling involving the sale of technology. The reported seller was duPont. The government applied the tax benefit rule, which says that if you've got a sale of technology written off, you should report ordinary income to the extent of your write-off.

o that if you had an R&D partnership and were selling the technology, you would have to report ordinary income to the extent of your deduction and anything received over that would be capital gains.

Most tax practitioners feel that that's not good law. Number one, it doesn't agree with the Hillsborough case, in which the U.S. Supreme Court set forth the tax benefit rule last year. Number two, it's a private letter ruling not usually cited as precedent.

On the R&D question, the R&D contracts, in order to assure the deductibility, provide complicity that the R&D contractor will only attempt, in good faith, to spend the money towards the R&D objectives. There is no guarantee of results. If there is, it will kill the tax deduction. So the answer should be, and I think it is, that there would be no liability, whatsoever, for the failure of the university, or any other R&D contractor, to complete the research successfully.

MR. MILES: John, could I comment?

The question about whether they're being audited, I think, yes, they are. In the northeast section of the United States, every Research and Development Limited Partnership, from what we can gather, is being audited by the IRS. Two of ours are now subject to audit. We have limited partners in various parts of the country who have been told that they will be audited. This doesn't mean there's anything wrong with them, it just means that the IRS is very eager about these kinds of things.

With respect to suit, there isn't any basis for somebody to sue the university, let's say, if the research and development doesn't turn out successfully. That does not mean they won't sue the university if it doesn't turn out successfully, as you all know. The allegation would probably be that they were misled in some way that was not disclosed in the document that was supposed to disclose everything that needed to be disclosed. When you deal with the public, I must say, the possibility of this happening is not remote. There are some pretty crazy people out there.

MR. DEARDEN: The next question is directed to Rich Schneider and is really a statement. "I see an inconsistency in your saying universities should not be a general partner in an RDLP because a university is non-profit, but could take an equity interest." Rich?

MR. SCHNEIDER: First the general partner has all the potential liability. That is not a good position for universities to take. In addtion it does not usually have the management personnel to serve as a general partner. The university could hold an equity position in lieu of royalties, and act much the same as a common stock holder. It might be able to invest a portion of, let's say, its endowment as a limited partner. Now, I'm not a lawyer, but from what we've been able to research so far, that seems to be a possibility. Maybe some of the other panelists could speak to that. I don't think any university has taken that position today. But I know when Delaware researched it, we really felt strongly that we should not be a general partner.

Does that answer the question?

MR. DEARDEN: Bill?

MR. MILES: Well, the problem with the endowment investing, is that it is probably not legal. They do have a fiduciary responsibility to invest the funds wisely and they do not invest typically in tax-advantaged investments where the risk is high because the tax advantage is supposed to make up for the risk. So it's kind of throwing the money away in a way.

MR. DEARDEN: Yes. I do know, for example at Hopkins, we have invested a significant portion of our endowment in venture capital funds, however.

MR. PETILLON: Also, I might add that in the Storage Technology partnership, which was a 50 million dollar private placement, there were a large number of tax exempt institutions that invested in that deal.

One model I've discussed with a couple of universities is their participating as a special limited partner. They do not put up money on the same basis as the other limited partners, but have a special percentage interest, issued to that institution for their research.

MR. DEARDEN: The next question is directed to Bill Miles and it asks "What guidelines would you suggest for checking out financial intermediaries?"

MR. MILES: Well, you know, it's always tricky. The best one is to know the people going in. Second, obtain references and talk to the people whose reference is given. If they are active in the venture capital community, you ought to be able to talk to other people in that community who are not necessarily given as a reference but would know them if they were active in the operation. There are an awful lot of what I would describe as amateurs in the research and development area. People who see this as a way to do something and go out and try to actually bootstrap a deal by going to a university and saying, you know, I've got the money when they don't have the money. If you'll do this, we'll support some research. Then they take the university's promise to do it, go out and market that as a way of raising the funds. But, I would check it. That's all I can tell you, check it out as far as you can with people in the industry and with references that you insist they give including legal references as well.

MR. DEARDEN: The next question is directed to Cliff McClain and the questioner asks, "What are the necessary, basic conditions and best mechanisms for creating a successful technological park in a regional area?"

MR. MCCLAIN: I don't know that I'm an expert at all on that question. We probably have some others that can address it better than I. I guess that the principal question that one ought to ask is the extent to which you have determined that a market exists for the use of the park by investigating those local or regional industries that exist, or perhaps some others from out of the region that would move into the park. In other words, do a market survey to determine what's needed.

I think that sometimes the success of the industrial parks, although it is claimed they were planned, occurs as much from what I'll call a correlation of forces which exist anyway.

Determine,if you can, whether such a correlation of forces exists; that is to say strong, local economic growth, a seeking by a number of organizations of the right environment in which to work, a growth in the rate of investments from a variety of sources, and a development of new industry providing a very nice environment and which relies upon the university in some way. A park that's associated with the existence of the university implies that it's a path for technology transfer. It can often work to the benefit of the university. One early industrial park that I had some experience with before I ever came into this business was one that was established in Huntsville, Alabama. It evolved from the desire of the University of Alabama to establish an extension center in Huntsville. But there was a varied, strong local growth area connected with the expansion of NASA and the Army's involvement in Redstone Arsenal, which sparked a lot of spinoff activity. Almost anyone that would have established a park that looked nice and had good buildings in it under those circumstances, would have reached success. As it was, establishing the Huntsville branch of the University of Alabama was, of course, an added incentive to go there.

So you really have to consider all of the assets in hand. My suggestion, of course, is that if the university is a source of ideas, that can be an added asset in planning such an activity.

MR. DEARDEN: Bill?

MR. MILES: I'd also just recommend that you talk to the local venture capital community. They might very well be able to give you some indication of what is happening in new ventures in the area that might be candidates for occupancy.

MR. DEARDEN: The next question, and I think we'll try to get two more questions in before we end, is directed to Lee Petillon. "Can American RDLP's be used to fund foreign R&D? If yes, does the limited partner remain eligible for a write-off? For example, funding of all or part of a research project through a Canadian research company or educational institution?"

MR. PETILLON: From the standpoint of the investor, one of the principal advantages of an R&D partnership, is a deduction against U.S. income, if the investors were subject to U.S. income taxes

As far as the R&D contractor being in a foreign country, there's no problem there. That would not render the deduction, otherwise deductible, nondeductible. As far as the royalty income is concerned, if the royalty income were coming into a U.S. partnership, with U.S. investors, the fact that the income was coming in from a foreign manufacturing firm should not adversely affect the otherwise favorable tax position to the U.S. investors.

MR. DEARDEN: The last question we will deal with is also directed to Lee and that's "Can a university be both a limited partner in an RDLP and hold a prime research contract from the partnership without incurring tax liabilities?"

MR. PETILLON: Yes, I think so. A limited partner, in order to maintain his limited liability, only has to not be actively involved in the management of the partnership. The fact that a limited partner, whether it's a university or some other entity, happens to have a contractual relationship with the partnership, pursuant to which it is undertaking the R&D, would not, I believe, in any way adversely affect the limited partner's limited liability.

Now, the other question which I think Bill and Clifford alluded to, is whether a university should be a general partner. I think that has very, very broad philosophical implications and should be the subject of a whole session at some future conference. The general partner can and does sometimes purchase limited partner units, but that's usually to invest in some of its own research.

MR. DEARDEN: Well, with that, I think we will conclude this particular session. I would like to thank you for being an attentive audience and I would like to thank the panelists for providing very interesting, informative discussions.

SESSION VIII

NEW COMPANY START-UPS FROM UNIVERSITY R&D

MR. DUMMER: In the opening session, you may recall that Ed MacCordy, President of the National Council of University Research Administrators, said a few words about the origins of this conference. Now, I will tell you "the rest of the story".

Ed proposed to a few of us in June--this last June--June of 1984 mind you, that NCURA sponsor a conference on the University/Private Sector Alliance, to be held in September--this September--now. Well, we told him he was crazy. He could never, during the summer months, create interest in such a meeting, mail the announcements, get any kind of a response to a major conference and then in addition, find adequate hotel accommodations.

A few days later, Ed told us that there was a window from September the 4th through the 7th that did not conflict with any other scheduled national meetings and that he had found hotel accommodations in Dallas, Texas. We asked Ed what he had been smoking lately. We told him that he would never get people to rush off to Dallas the day after Labor Day or sign up the right speakers on such short notice, and that the moderators would have no time to talk to their panelists and organize their sessions. He said he appreciated our advice and our concern but not to worry--he was going to sit down and make a few phone calls. Well, a short while later, a very short while later, I received in the mail the first program announcement and discovered, incidentally, that I was the conference Chairman to boot. The people you've got to watch out for are your friends--believe me.

Well, I won't bore you with the chronology from there. Ed MacCordy, with yeoman help from Fred Bentley, your Conference Director, and Natalie Kirkman and Kathleen Larmett from the Washington office of NCURA, and with the help of a dedicated group of people, pulled this program together. I feel compelled, publicly, to eat my words and apologize to Ed. He's not crazy after all. I think he has really pulled it off. If you agree with me, I hope you will join me now and let Ed know it. (Applause.) If you hadn't noticed, Ed, Natalie and Fred Bentley are standing in the back of the room. I think you probably know who they are.

Now, with that aside, I have one housekeeping announcement. Ed MacCordy is currently planning another conference which will be a follow on to this one. He intends to hold it in Anchorage, Alaska, the day after Thanksgiving and you can register in the lobby.

MR. MACCORDY: This Thanksgiving.

MR. DUMMER: You don't get any rebuttal time, Ed.

Now we turn to Session 8, "New Company Start-Ups From University R&D." I would like to introduce Duke Leahey, Director, Research and Contract and Licensing Administration of Washington University.

MR. LEAHEY: Thank you, George. Welcome to Session 8. In taking a look at the things we have done for the last few days, I really don't believe there's any issue as exciting or as challenging as the new company/university alliance. There are more important issues in academia right now, but there's nothing as much fun. Universities have been sought after as a source of new technology, and now we also are sought after as investors. During the last few years, universities have invested 350 million dollars, according to Venture Capital Journal and these venture capital partnerships were mostly funded since 1980. So there's been a tremendous growth in the last two years of venture capital funding in this area.

We're watching private sector and university relationships evolve beyond the simplicities of sponsored research, beyond research supported through contract mechanisms. As outlined in the pamphlet generously provided by the Boston law firm Herrick & Smith, which was in your registration packet and was discussed earlier in this conference, private sector-university ventures are very complex. These interactions require knowledge of intellectual property licensing, venture capital financing, joint ventures, equity formation in R&D limited partnerships, Subchapter S Corporations (occasionally formed by our own faculty members) and finally, something that will be discussed later, the university-owned development companies and innovation centers.

Because new companies emerging from university R&D require a great deal of capital in the initial and the following stages, universities are now anxious to support the formation of venture capital funds with which strong ties can be maintained. While a few successful ventures have developed, there are criticisms of these arrangements with the private sector. The critics say that these new relationships are a departure from our traditional role of education, research and public service, while proponents of the private sector/university alliance claim that a pro-active response by universities to national and regional economic development is the greatest public service we can possibly offer. For years, small companies have been formed around university-generated technology, but there's a growing interest in institutionalizing the process by some sort of viable arrangement between universities and the venture capital community. Hopefully, this will increase the value of start-up companies significantly, providing better opportunities for our entrepreneurial faculty members, while retaining them in the university.

For the past 15 to 20 years, universities have concentrated primarily on licensing programs aimed at transferring technology to large corporations on a royalty basis. I doubt that anyone would assert that these programs had been a tremendous success for the majority of us. These limited results have raised questions as to whether dealing with medium and smaller companies, plus the capability to create new companies, might not greatly improve technology transfer functions in universities accompanied by an increased financial return. Here today is a panel of people who are out there doing it. I hope that they will provide some insight as to what they have done and how to organize for this alliance so that we might be able to effectively participate in terms of rethinking our policies and attracting the capital that we so badly need.

Our first speaker is Robert E. Mittelstaedt. Bob has been with the University of Pennsylvania since 1973, where he currently serves as Director of the Wharton Innovation Center and Senior Lecturer in Management at the Wharton School. He is a founder and is active with M. P. Ventures, Inc. Prior to founding the Wharton Innovation Center, Bob served as Director of the Wharton

Applied Research Center and served for six years in various capacities, including Associate Director and acting Director with the Leonard Davis Institute of Health, Economics and National Health Care Management Center of the University of Pennsylania. Bob's experience prior to the University of Pennsylvania includes two years as a project manager with the consulting firm Enviromed and five year's experience as a U.S. Naval Officer in the Nuclear Submarine Program. He recieved his Bachelor of Science in Mechanical Engineering from Tulane University in 1965 and an MBA from the Wharton School in 1971.

Bob's research has focused on venture capital, technology based business development, economic impact of new ventures and strategy/technology relationships in a number of fields.

Bob Mittelstaedt.

MR. MITTELSTAEDT: Thank you.

Sometime ago, I was approached by a group of students who had a new business idea. I have to tell you that these were not people that were at the top of the class. They were interested in leasing one of the new recoverable space shuttle vehicles to fill a market niche that they thought was there for missions to the sun. When it was pointed out to them there was a serious problem in terms of heat and a variety of other things, they studied the problem and came back with the answer that it was okay, they'd be able to go at night.

Now, I presume that those of you involved with research administration and with faculty that worry about putting new businesses together from time to time, see a lot of proposals where the ultimate answer is, "we'll have to go at night". Is this interest in new business development and new start-ups an entrepreneurship fad; is it something that is going to pass? Let me read you a quote about a fad of the past. In 1957, the editor in charge of business books at Prentice-Hall, responded to a submitter of a manuscript on the new science of data processing, by saying "I have traveled the length and breadth of this country, have talked with the best people in business administration. I can assure you on the highest authority that data processing is a fad and won't last out the year." We hear lots of those kinds of things. That's one of the major issues in this business of new start-ups and new ventures, whether you are talking about it from the perspective of the venture capitalist, or you are talking about it from the perspective of the university administrator or even from the standpoint of the entrepreneur or the scientist himself that's interested in it. Is it a fad, is it something that's going to last, is it something that we need to be concerned with? The broader issue of whether entrepreneurship in the university is a fad or not, is one on which I have a few thoughts. I'll give you a few hard facts that lend some substance to the issue and provide you with some other subjective opinions.

The first is that strictly from a demographic standpoint, entrepreneurship is here to stay in big proportions for at least another decade. It has to do with all those little turkeys we call the baby boom who caused the problems when we didn't have enough grammar schools and when we didn't have enough junior high schools and we didn't have enough high schools. Now they are all in the 25 to 38-year old age range. That's part of the reason for the rising interest in entrepreneurship. Most people, if you look at the history of entrepreneurship, take their first serious risk between the ages of 25 and 40. That's where that age group is concentrated most heavily right now. That affects the universities

as well as society as a whole. So from a demographic standpoint, we have more people that are at the age where they are typically willing to take risks, than we've ever had before. That, as I say, will continue for another decade as that group moves through the population and the numbers drop off a bit.

Entrepreneurship is still a significant phenomenon, given that we've been through a long period of time in this society without serious economic problems. We don't have people in that age group who personally remember living through the depression and who aren't quite as afraid of taking some risks.

Societal attitudes toward risk taking in general have changed a bit. Winning is okay again; it's all right to do this kind of thing. The kind of illustrations that you saw this morning with the cover of Venture Magazine and others, have made entrepreneurship okay. Now, that has carried over into the university as well. It affects our faculty as well as people in the population as a whole. So I think that the trend is here to stay. It's not a passing fad, it's something that we have to deal with in some form in all sectors of society and certainly within the university.

We heard a lot about licensing and discussions about the pros and cons of RDLP's and a variety of other mechanisms. But the new venture where the faculty member is interested in starting the business and participating in the business himself, is a slightly different animal that raises a series of additional problems. The differences are substantial. In the licensing situation, the risk is heavily removed and it's primarily the licensing organization which is taking the risk. The reward is smaller and even if there's a big distribution program within the university, the potential reward to the faculty member involved is certainly of a different magnitude. It's usually done through an existing organization. It doesn't require big changes in organizational structure or redirection of the organizational purpose.

With the new venture on the other hand, the risk is very significant and very personal. Very often, the person involved--and you heard venture capitalists talking about investing in people, not in ideas--the person involved is someone who's going to take a significant career risk, a significant financial risk perhaps, but certainly something that if he fails on any significant scale, its going to have an effect on his life and on his career. The rewards, on the other hand, are much greater. Finally, entrepreneurship requires new organizational relationships. The new organizational relationship is particularly complicated within the university setting because of the very nature of the university; because of the plurality of interest that we allow and that we foster in a university.

It's quite acceptable for a person, and I have done it myself, to state to my boss, the Dean, I'm notifying you under the unversity policy that I've incorporated a company and in my private time, I'm starting a business. He says, okay, you've notified me, go ahead with it, just as long as it doesn't interfere with whatever else you're doing. Now, I know a lot of corporations, where if the word just gets around that you're thinking about that, you're viewed as a traitor and you may even be fired. That's a very different circumstance than we have here. One of the underlying fundamental issues that you have to deal with is the fact that you can go through a certain investigatory phase and reach a point where you have gathered information, have evaluated alternatives in relative safety, without jeopardizing your current situation. It's easier to go further, to get a "little bit pregnant", if you will without jeopardizing your current situation in the university environment. That happens an awful lot.

Now, what are the reasons that an individual scientist, an engineer, physician, or person in a business school or anywhere else that has a business idea, would be motivated to choose licensing at no risk, at relatively little work on his part, versus the new venture with greater work, and risk? Certainly, I think that while he may not realize it, the biggest factor is the personal one. Am I an entrepreneur? Can I put a business together? Can I do the things that are going to be required in terms of the time and the dedication and the effort that's required to make this thing happen? Most people who have started any business of substance, will tell you that if they had understood what was involved before they began, they might not have done it. It doesn't mean that it should be done by somebody else; it doesn't mean that you are not going to be successful, but that's a question that each person has to answer as an individual. I think that the answers to that vary rather dramatically. Even in a university, not everyone wants to do that; not everyone is oriented that way and for various personal reasons, such as a time in life with children in college, or whatever else, he may not be able to do it. So the biggest reason for choosing one path or another is personal in my view. That's the part that the venture capitalists are interested in and they're interested in understanding that commitment. So for people involved in research administration in a university, to the extent that you get involved in evaluating new ventures evaluating that person's commitment, is part of understanding whether or not his idea is going to go very far.

Obviously, there are a series of other things, including the additional amount of R&D that's required. It is not impossible to raise 20 to 50 million dollars nowadays for a new technology before there's a product ready, but it's not done every day either. So the amount of R&D that's required, the resources that are required from the standpoint of special capability and so forth, may influence that decision as to whether you license or whether you start a new business. The characteristics of the market, the size of it, the dependency on a whole product line and whether you will produce a whole product line at once or a single product are factors which must be considered. The ability to license it is also a factor. You know, Western Union turned down the right to the telephone back in whenever. There are all kinds of these stories. No matter how good it is, you may not be able to license it. If the entrepreneur is seriously committed to his idea, he may have to start a new business because he has no other vehicle. Regulatory costs, especially in the medical area, with the FDA, can influence that decision. Other barriers to entry, complimentary technology with manufacturing capability and so forth, will also influence that decision.

Let's assume though that this faculty member has decided that after going through all these reasons in a subjective fashion, he's made the decision that he wants to start a new business; that he's ready to do this. I'm going to have to have you imagine for a moment, a conversation between the research administrator named George at this university and the faculty member named Fred who encounter each other accidentally in the halls at I.B.U. Through advances in modern technology, we are also going to be able to listen in on the private thoughts of each of these individuals as they go through this conversation.

So over here we have George, the research administrator and over here, we have Fred, the faculty member.

"Hi, Fred, how's it going?"

"Hi, George, fine, thanks. I've been meaning to call you. There's something I've been working on that may have some business potential at the university." Thought: I busted my rear here for 17 years while guys I went to school with are out running their own shows, in charge of their operations. Some of them are even millionaires. It's time I got something out of this too.

Thought: Oh, boy. The last time I saw this guy, he'd invented a nuclear fusion device in his basement at home without the use of university resources.

"Gee, that's great, George. In this new environment, we need more guys like you, thinking about the interaction of research in business. What's your idea?"

"Well, I have a new underarm alarm to tell you that your protection is running out. Some business school students have done some market research and we think it has big potential. In fact, I want to start a company with the university participating since the underarm alarm was developed partially under the Skin and Pit Center Program." Thought: Developed totally under the program if the truth is known, but what will they do, fire me?"

"Sounds interesting, Fred, but what if it fails and someone sues us for, you know, excessive, undetected wetness leading to catastrophic clothing failure? Would the university be liable if we go into this with you?" Thought: Sounds like something that could leave us with some parts exposed unnecessarily.

"No problem, George, we're talking minimal exposure here." Thought: Unless you think about the problem of people sweating with electrical leads under their arms, but he didn't ask me about that.

"Fred, what kind of arrangement with the university did you have in mind?" Thought: Probably wants to license the device from us for one-tenth of one percent of net profit after tax if we pay for the development.

"I was hoping the university would invest $250,000 in a company of which I own 93 percent. We would then pay the university a royalty on sales." Thought: My brother-in-law has to get something for his legal work too. I wonder how little the university will take. What I really want is to continue to use my university facilities. "We'll pay rent, of course." Thought: How about a dollar a year. After we raise capital for the company, I'll go on leave for two years. Preserving tenure and seniority, of course.

"Well, Fred, that sounds like an interesting proposal." Thought: And ridiculous, too. "We'll have to talk about the details, of course, a few things to be worked out there." Thought: I'd love to work this out, but it may be impossible, given his expectations, the complexities of university policies, which I can't do anything about. Maybe he should license it to someone in the business. "Have you talked to Joe Graham, Chairman of our Trustees, he's in the underarm business, you know."

"No, I haven't, but that's a good idea. Thanks, George." Thought: I don't want to talk to Joe either. He's the guy making reinforced t-shirts I want to put out of business.

"I have to run, let me know how it's going and when we need to talk again."

"Sure will, Goerge. Good seeing you." Thought: Sorry I mentioned it. Maybe I should just say I developed the underarm alarm on my own time to keep my girlfriend from going home early.

Is that what you have to deal with? Have any of you had a conversation like that? I think there are some elements in there that each of you, as research administrators, have heard from time to time. Obviously, the issue of personal preference involves whether or not the individual is acclimated to and wants to form a business himself. It's also a question of whether or not the university will formally invest in a program, whether it will license it to the employee. This whole area of whether the university can and should get into business relationships by licensing something to a person who is still an employee---where you then have a dual relationship---is a complex one.

Ownership is a question that comes up all the time. Clearly, in a licensing venture, it almost doesn't come up because the individual has said I'm not interested in pursuing this. Let's license it. Then the university more or less deals with it in its entirety. In other cases, the question of ownership comes up and it usually gets pushed in the direction of the university owning a little piece of the venture, but it's not clear how much.

The liability issue, which we've heard talked about today, and questions of jeopardizing the tax status because of unrelated business income if the university gets involved in a formal venture, whether it's a partnership or a corporation are additional issues. Competition with other constituents is a non-trivial consideration. The idea of competing with other people in the business community aided and abetted by the university when those people are members of the trustees or alumni and donors is something that is not often talked about, but I think it is a real issue.

Finally, there is the question of conflict with academic work, which is the sort of question that's always raised first. I think in that case, there are many instances where we have to look carefully at what it really does contribute and the spin-off effects in terms of educational benefit, additional research dollars, and attracting students that learn from these things.

What do you do when you are confronted with this situation? I will tell you briefly about some possible structures or some possible mechanisms. But the first question that is very simple, and that has to be raised, as I just said, "is it consistent with the mission?" Is there something that we can get out of it as a university, whether that's research, teaching, retention of key personnel, or fiscal integrity? Does it make sense from an academic or a business standpoint and can it be structured legally and politically? Frequently, I think the political issue is the one which kills these ideas. It's not a question of not being able to do it for other reasons, it's a question of not being able to do it just because people don't want to in some cases.

How do you sort all this out? Let's say, just for example, that there are a range of things that you see from time to time. I'll just use some real ones that Tony Merritt has seen at the University of Pennsylvania in recent years, from the polymer battery which has huge potential and was licensed to somebody else with very big markets, to technologies for electronic stimulation of bone growth, down to instruments to detect pulmonary edema, a relatively small but important medical market. The range of things that you see is huge. Every faculty member thinks that his or her idea has big potential. Let me suggest to

you that you take the kind of criteria that some of the panelists talked about this morning--that venture capitalists utilize--and you can find those in reference books and a variety of places. You look at these first of all, from the standpoint of determining whether or not it even makes sense to talk further about it. Until you have answered the business question, all the questions about how you are going to slice the pie are irrelevant, and you end up slicing a pie that hasn't been baked. You spend all your time arguing over whose slice is what size and it turns out that the thing doesn't even have any serious business potential. You've got to answer the business potential question first.

I think that from a case by case basis, universities have to evolve standard policies about these things. You can't use the case by case methods for resolving them forever. While that is what is traditionally done, each of these is dealt with as they come up. I think this approach builds in some frustrations on the part of the faculty members about the fact that there is no mechanism and they worry about that.

The organization that I run, the Wharton Innovation Center, was founded about five years ago, with the idea that we would help entrepreneurs, inside or outside the university, evaluate the business potential of their idea or system by writing business plans, doing market research, and, when appropriate, in finding sources of capital. We have successfully done that. We have worked with many people. This was essentially an internally funded activity of the Wharton School, because from the perspective of the Wharton School, it was consistent with our academic mission--that is, to give students a broader educational experience. It gives them practical projects for those that want to go into the venture capital industry. They beat down my doors to get involved in these real world projects before they graduate. But there are a variety of other mechanisms that can be used, from the less formal to the most formal. The informal approach is the one that's used most often by universities. That is, let's worry about it when it comes up. That's the one that worries me because it makes people paranoid. I don't carry out my activity as a representative of the university administration in terms of its technology commercialization policy; this is an activity of the Wharton School, so I don't have that administrative responsibility. I'm visited frequently by faculty members who worry about even talking to me because I'm part of the university and whether or not that would then entitle the university to some portion of ownership of their idea. That's a major concern. There's a general concern about not having an explicit policy. I think this issue has to be dealt with.

Some kind of infrastructure encouragement in incubator space, which doesn't get directly into the business activity itself, but which encourages people and assists them physically in getting to where they want to go, is one level of support that is relatively safe. Providing business services as we provide through the business school, is relatively safe in that it's a separate activity and we get compensated for that by working out an arrangement with these people. It doesn't jeopardize their relationship with the university as their employer. Other kinds of minor support in terms of providing money and funds for patents, prototypes, copyrights and so forth could be provided, also.

The direct infusion of capital, obviously, is a step that is a little more formal. We heard about that with respect to R&D Limited Partnerships. We heard about it with respect to the idea that was proposed this morning regarding a consortium of universities. Indirectly, this can be facilitated by universities

investing out of their portfolio into venture capital partnerships and the informal relationships that develop there. So those kinds of things can all facilitate new venture activity.

With regard to active business development, I don't see or recommend that universities go into the business of forming companies themselves. I think that they need a policy that allows faculty to do this and allows faculty to continue to exist within the University, because faculty are going to continue to form businesses. I think that as was suggested somewhere along the program, ownership in technologies ought to just be given to faculty from time to time. In the longrun retaining them there may be in the best interests of the university and its faculty, because successful people can find a way to be successful somewhere else.

Entrepreneurship is here to stay. It's real. It affects faculties. They want to form new businesses for a variety of reasons. The piece that you have to keep in perspective when you discuss and debate this issue, is that it's still a relatively small proportion of the faculty that are even going to care about and be interested in this. The faculty is not going to stampede your office or the trustees about this. There's going to be a small number of them. But that small number over time can be significant. I did not stop to count, but I would guess that I could name, if I were given 15 to 20 minutes to think about it, at least 25 businesses that I know of that have been formed by faculty members between Wharton, Engineering, and Medicine at the University of Pennsylvania in the last three or four years. Those are business of some substance, not just a faculty member incorporating his consulting, but businesses of some substance. It takes place because they're creative people.

My final recommendation is just that you have to be prepared to deal with it. I think that is a policy issue; it's got to be addressed. It's very difficult to address in the abstract though. You almost need a case example as a vehicle because the discussion gets too dispersed to try to come up with a policy otherwise. My final recommendation then, is just don't end up like Pogo who looked at the situation and surmised that we are surrounded by insurmountable opportunity. Thank you.

MR. LEAHEY: Thank you, Bob. Our next speaker is M. Campbell Cawood. Campbell graduated with a B.S. Degree in Commerce from the University of Virginia, where he was a duPont scholar and has an M.B.A. from Temple University. After serving in the U.S. Army, he began to work with the Trust Division of the Girard Bank in Philadelphia, where he held several positions including an Estate Administrator, Business Officer, and Securities Analyst. In 1976, he joined the Capital Management Division of the Wichovia Bank in Winston-Salem, North Carolina. While there, he counseld, advised and managed the financial affairs for several of the bank's individual clients with high net worths who maintained varied interests in business affairs including venture capital. In 1978, he was co-founder of Salem Investment Counselors, Inc. and in March, 1984, he co-founded Venture First, Limited.

Most recently, Campbell has spent a concentrated period as a special guest of a venture firm in Menlo Park, California. He is a charter Financial Analyst and President of the North Carolina Society of Financial Analysts.

MR. CAWOOD: Thank you, Duke. I'm grateful for the opportunity to speak with you today on the subject of venture capital and the university, or the marriage of business and academia. I'm especially honored to be in such distinguished and knowledgeable company. When the stage is set such as this is, I feel confident there will be a positive impact on the future of the universities.

Business and academia have been perceived as two inherently different and often conflicting concepts. The foundation for the argument is not new. Businessmen have been at odds with those seeking academic freedom for centuries, but now, changes are occurring every day. The academic community now feels left behind by those who have capitalized on research efforts funded by the universities, and businessmen are beginning to acknowledge that science and humanism can have a positive impact on the bottom line. An exciting dialogue is now underway discussing how academia and business can work together, laying a foundation for changes in what had previously been conflicting paths. We at Venture First hope to be one of the catalytic elements in the process to transform concepts and theory into investment opportunities. We're optimistic that our time and capital can be invested productively. From our view point it would be a mistake for venture capitalists to ignore the universities.

May I suggest a few trends affecting universities today which accentuate the need for alternative and creative financing?

First, the demographics are working against you. This is old news to you since you all know the baby boom is over. Universities are now faced with a trend of a declining enrollment and expanding costs. This means that traditional budgetary pressures will be even greater in the future since the revenue stream from tuition is under severe pressure.

Second, the Federal Government's role in education and research is diminishing. All types of government spending are being evaluated and reevaluated. I even suspect that defense and transfer payments are not truly sacred cows. Education was the first to feel the impact of budget cuts and don't be fooled by the eye of the storm. As long as there are unconscionable deficits and our economic policies flip-flop between deficit spending and inflation, universities should not count on grant money as sustainable. Although I personally believe that university-funded research should be a national priority, there is a strong and emerging lobby who do not share that view. This too is not news to you.

Third, services are moving out of the public sector and into the private sector. Historically, the government has been the primary delivery vehicle for services to our society, and the private sector delivered the goods. These roles are changing dramatically. Now, the private service sector is the fastest growing part of our economy, and universities are directly affected. Examples are hospitals and laboratories, many of which are shifting into the private sector. Several of the very best biotechnology labs in the country today now have "Inc" after their names and are recognized for their academic excellence. Nobel prizes are no longer the sole domain of the university community. In spite of this transition, we still believe that universities have a competitive advantage and that a high potential for breakthroughs exists in areas interesting to the business community. It is in the universities where we expect that "spark of genius" to be nurtured. We hope that the process we're discussing here will provide an even more conducive framework.

Fourth, the technological and information society is causing all of us to reevaluate priorities. Most everyone in this room has been directly affected by some new technology or new twist on an old technology within the past two years. This speech was written on a wireless nine pound portable computer with more memory than an IBM-PC. Our phones are different, there are all sorts of new machines in our offices, and even our cars talk to us. Today you are here seeking more and more information. As a society, we are having to learn new skills and thought processes. A large part of the burden to prevent this from turning into chaos rests with the educational community. Naturally, this means more operating and investment capital is sorely needed to meet these new challenges.

A by-product of this reality is that technological changes are occurring so rapidly that you can't afford to expect a long term payback on an investment. Dollars spent today on technology are likely to be obsolete tomorrow, but the cost of deferring those decisions is even greater.

To this point we've discussed problems. We've talked about demographics, the federal government, how the economy of our country is changing, and asserted that technology will play an even more important role in our future than in the past. Let's turn to solutions and examine further trends of a more positive nature.

I. Public Law 96.517. All of you can educate me on the technical aspects of this important new legislation. Perhaps some of you lobbied for it. Now, for the first time, universities know who owns the commercial rights resulting from grant money supplied by the U.S. Government. One of the potential legal obstacles has now been removed when you or others consider a product or disclosure for commercialization. Now that the government has done its part and transferred substantial value to you, the ball is in your court to equitably slice the pie between the professors (the workers), and the universities (the owners of the capital) -the age old division between labor and capital. I know all of you have addressed the subject, but let me observe that labor's cut in a mature industry is approximately 40% of the revenues and is even more in labor intensive industries. When we look at service industries and especially software, labor is the lion's share of the revenue stream.

By these observations, I'm suggesting that the slice of the pie going to those who create commercial products should not be an absolute. Please be sure that proper incentives are structured so talented individuals will not have an excuse to try and find a way around the system with everyone losing in the process. Be as clear as possible about your contractual agreements with professors and especially those who are working in science, but allow room for flexibility. Nothing is advanced when greed takes control. We have seen some professors confess to us that certain scientific procedures are an art form, unique to them and cannot be duplicated or patented. Others have even suggested that the patent office of their university is where you go if you want to be exploited. What this means to me is that they won't transfer their knowledge to either the university or to us. Policies should facilitate and not deter creativity. When people know they're being treated fairly, the potential for an unlimited return, a definition of equity, is enhanced.

II. The venture capital industry is beginning to mature and is becoming a respected form of investing, and even accepted by conservative investors. The venture capital industry is very small compared to the size of the publicly traded debt and stock markets. There are, however, now billions of dollars available for investment in private transactions where the investor will be giving up liquidity in exchange for substantial strings on the manner in which the money is spent. Think for a minute. When a portfolio manager buys GM stock, his vote hardly counts. But, when venture capitalists buy XYZ stock, their vote is the difference.

Some of you may believe there is now too much money committed to venture capital. In 1983 $3.4 billion was raised for future commitments and almost that much was invested. IBM alone will spend over $3 billion this year on research and development. In aggregate, the new business development budgets for large domestic corporations are multiples of those amounts. The difference between what we do and what corporations do is in the reward system or the spirit of entrepreneurism which we believe is developing with a vigor in our country.

We also believe that the aggregate numbers for venture investing haven't increased so much as has the fact that most of it is now professionally managed. Venture capital has advanced to a state that has left behind the "high-flyer", "try it to see if it works" mentality. It is acquiring new measures of discipline in the process. Indicative of this is that pension funds are now a very large participant in the industry. Basic to the concept is a reduction, not an increase, in risk. When venture capitalists are involved, you're dealing with people who are dedicated to investing every dollar responsibly and bring substantially more than money to the table.

We've established that universities have a need for new sources of financing in the years to come and then noted some positive trends taking place that enable universities to do more than they've done in the past. Now, let us be more specific and explain the criteria we at Venture First use when we consider funding a new business:

I. Management. This is the most important criteria. We ask, does the individual or group of individuals have that unique ability to be an entrepreneur, to inspire leadership and take on what may at times appear to be an impossible task? Or, do they measure success by the frequency and amount of a paycheck? Are they willing to make sacrifices for a long period of time to see the business through its development? All this says is that we look at people first and size them up. Many who are coming to us with ideas and concepts are not capable of running a business. Part of our process is to educate them on the elements of a good business and, if necessary, convince them that another manager may be the key to its success. Please understand it is not our goal to manage businesses but, rather to see that a capable management team is in place.

II. Product/Services. Exactly what is being proposed? Let's do the proper due diligence and find out if the representations are what the entrepreneur say they are. What is the competition? Does the product really work or are more development or regulatory processes necessary? Have potential end-users tried it? Can it be sold in the market place for a reasonable margin? What are the price and cost sensitivities? Will it fit into a fast-growing market and enjoy a reasonably long life expectancy? Is the fact that it is patented the only defensible part of the business plan?

III. Market. Let's take a good hard look at the big picture. In what industry or segment of an industry are we looking? Or, is a complete new industry being proposed or created? Is this industry one in which we want to make long term commitments? Let's look at trends. Can this product fit into this industry in such a way that it can become dominant or continue to gain market share over the long term? Are the margins such that you can be wrong about the trends and still obtain extraordinary returns? Can a business be structured with the potential of being a $25-100 million business in 5-7 years?

IV. Finance. How much money is required, and how long will this business take to become profitable on an operational basis? What form will our money take on the balance sheet? Exactly what will our money be used for? (Cashing out previous investors is not the intended purpose of our capital.) Who are the present investors? How interested and capable are they to see the development through the various stages of growth? What is the valuation? Is it in line with comparable marketable valuations and adequately adjusted for risk and return?

V. Influence. Do the entrepreneurs share our goals and standards of doing business? Do they realize that we must see vehicles for liquidity in a relatively short time horizon? Will they listen to advice and actively seek it? Will the investors have the ability to replace management in a time of crisis?

These are all areas we scrutinize carefully before we invest money; but, I assure you that if everything went according to our ideal plan, we wouldn't be in business. Now let's consider what the real world of venture capital is all about:

*Hardly anything works as the inventor expects it.
*They usually don't have any idea who will buy it or what someone may pay for it.
*Costs of manufacturing or operating controls are foreign languages.
*They have probably never been in a small business let alone started one.
*Their family may have lent them some working capital, but they still are holding on to some form of employment with commensurate responsibilities.
*They think everyone is trying to cheat them or steal their ideas.
*Control is everything to them, and they seldom understand that several rounds of dilution in ownership is necessary when a company is successful and on a fast growth path. (It is this growing process we seek and believe that it creates the potential for substantial returns.)
*They initiate the discussion with us using phrases like "loan" and "rate of interest," thinking we're bankers.
*They want enough money for two years and for us to leave them alone so they can make the "thing" work.
*They expect us to pay for the services they deliver to the new business of which they are part owner at a rate at least equal to their previous salary.

After we wrestle with some of these basic misconceptions, we can then get into the deal itself and call on our experience and imagination. Given our criteria, what is needed to fill in the holes? Do we have the resources, not just financial, to truly add value to the concept and put the puzzle together? It is in this role where seed venture capitalists actually become part of the founding fathers and orchestrate the beginning of a business.

You as patent administrators can do more than just license products to industry. You and the university must realize that if you want a higher return, a trade-off comes in the form of little or no money up front from venture capitalists. Large companies will pay you for royalties and licensing agreements but will seldom share part of the profits. Should you believe the market for certain of your disclosures is substantial and a stand-alone business can be built around them, then, you should talk to venture capitalists. The returns can be extraordinary.

Several universities have quite successfully invested in venture capital via the limited partnership route. I think it is a very high risk endeavor to try to become venture capitalists yourselves. The characteristics to be a venture capitalist are not generally found within a structured university environment.

Now, a plug for Venture First...

Our fund is a limited partnership with over $11 million in committed capital to date and structured along the lines of well-established funds in the industry. Our investors consist of bank holding companies, insurance companies, foundations, pension funds, other venture capitalists and individuals. It has a regional focus (the Southeast) and has targeted seed and early stage businesses as the preferred vehicle for our investing. The regional focus will enable us to spend our traveling time more productively and to foster business development in an area where we have a substantial support network. The area has a growing technology and health care base and very little professionally managed venture capital. We've chosen to emphasize seed and early stage venture investing because we believe the highest returns can be realized there with very little additional risk (if milestones are properly structured), and it is consistent with where we perceive the need is for venture investing is in the Southeast.

In summary, today we've explored some negative and positive trends that are affecting universities and introduced an argument that there is substantial value in the university structure of special interest to venture capitalists. I gave you an idea how we think, how we judge our investment alternatives and a bird's eye view of what we see in reality. I hope you understand us better and we can look forward to many years of mutually rewarding and profitable investing. Thank you.

MR. LEAHEY: Our next speaker is Ian R. N. Bund. Ian is general partner of Doan Associates and The Michigan Investment Fund. He joined Doan Associates in 1976 after five years in Hawaii, first as President of Sea Life, Incorporated and subsequently as a consultant to that company after its sale. His prior experience includes venture capital as an Officer of Research and Sciences Investors, Incorporated, investment banking as an Associate of Morgan Stanley & Company and public accounting with Price, Waterhouse & Company in Sidney, Australia. Ian is an Australian chartered accountant with a Bachelor of Economics Degree from the University of Sidney and an M.B.A. from Harvard. He is the director of several companies and is a frequent speaker on the subject of economic development, venture capital and business financing. He is a Governor of the National Association of Small Business Investment Companies and Vice-President of The Midwest Regional Association of Small Business Investment Companies. Mr. Ian Bund.

MR. BUND: Thank you, Duke. It's good to be here today. Our firm was started by Ted Doan in 1971. He had formerly been Chief Executive of the Dow Chemical Company and Vice Chairman of the National Science Foundation. He started the firm convinced that small companies are the most efficient way to get innovation to the marketplace. I think he learned this serving on General Dorio's Board at American Research and Development and through Dow's in-house venture capital firm.

I thought I would start out by defining the way we look at venture capital. Very simply, it is the business of developing businesses, and not really a financial discipline, but a technique and methodology for building companies. That's the business we're in. Our firm consists of three commonly managed venture partnerships with about $90 million of assets. It's dedicated to developing companies in seven industries: the life sciences which we define as medical technology, biotechnology and health care services; industrial automation; computer hardware and peripherals; computer software; advaned materials; semi-conductors and equipment for semi-conductor processing; and communications and information systems. It's interesting to note, looking at the statistics included in the registration folder, that several of our concentrations are also major targets for university R&D. So I believe we may have much in common.

Seventy to eighty percent of our investments are initiated by us singly or jointly with others. We enter investments through start-ups of two types and buy-outs. We describe the start-ups as idea start-ups on the one hand and rolling start-ups on the other. Since today's subject is start-ups, I'll concentrate on this subject.

Now, start-ups tend to have their genesis in research universities and the R&D departments of larger companies. Let me talk about some of the university start-ups we've done.

First, I'll define my terms. The ideal start-up, I think, is the science-based start-up that a lot of you have read about in recent years. One of my partners thinks of it as very much like the hail Mary pass with four seconds to go at the end of a football game. But we're very pleased with the relationship we have with Neogen at Michigan State. At Michigan State, my partner, Phil McCarthy, previously President of International Nickels Venture Group was involved in setting up the Lipizone Company at Princeton, and Plant Genetics at U.C. Davis & Cornell. We were among the cheering squad in working with Bill Jackson, who's here today, in setting up Repligen around some brain power at M.I.T.. and Integrated Genetics, another group out of M.I.T. and Yale.

Let me talk a little bit about Neogen. About five years ago, some senior faculty people at Michigan State came to us and explained that some of their research stars had recently been wooed away by some terrible eastern schools. These schools were offering them the firm, a piece of the action and this, that and the other and what could be done about it. We explained that we are in the business of getting a very high return on investment for our partners and that consulting with universities is something that we enjoy, but we really weren't about to expose dollar one unless we could se a R-O-I. This was received with mixed feelings, but nevertheless, the dialogue continued. Before long, it became apparent to us that the strength of that school in the agriculture and veterinary sciences could lead to a viable company that would be involved in developing projects in those areas.

Nothing happened until we were able to locate an outstanding entrepreneur who would have the objectivity to lead these efforts. When we were able to recruit Jim Herbert, a previous senior executive with Cal Agrisearch, the ball started rolling and since then, has moved ahead successfully with five projects, with every kind of financing that you could think of. We've done two R&D partnerships, and SBIR, and a State of Michigan grant. We've done a project with some foreign companies using contracts. So to follow ujp on the point that Pat Cloherty made this morning, all sorts of finances have been used to push forward the design for this company. We've taken, if you will, a lot more of a bootstrap approach. We have not swamped the entrepreneur with all sorts of money. We are pleased to say that of the five projects they've gone ahead with, that all five are on or in some cases, ahead of the research and development goals.

Turning to what I referred to as rolling start-ups, I'll give you some examples there. There are four that have been developed in the life sciences. We define a rolling start-up as the kind of start-up where you, at a very early stage, develop strategies to produce revenues. In other words, sticking money down a rathole is fine, but unless you're very early on developing the disciplines of a real business, you will not be successful. There are four examples. First, is a company called Innovative Hearing, and the brain power for it was provided by a surgeon at Stanford's Medical School. It addresses the problem that many of us face in the natural aging process, we begin to have a mild loss of hearing. He came up with this non-electronic hearing aid and two of them cost about $160.00. It's like an old-fashioned hearing horn, it provides a downshift in the frequencies. For those with a mild loss of hearing, it's been very successful. We, after some deliberations and an initial investment by the venturers of $10,000, determined that indeed the idea was a good one. We decided that the route to the marketplace was a retail store. We quickly put one together. The day after the FDA approval came through, we opened for business. We are now doing daily revenues at about the rate of the highest producing hearing aid stores around the country. Here's an approach where we very quickly got it to market. We tested out whether the world wanted it or not. Our first two efforts in the market place went very good and then finally we figured out how to do it and it's coming right along. We're about to open additional stores. We have a full time management crew and they produce monthly financial statements with an eloquent report from the President. At our monthly meetings, the management group gets a pretty thorough grilling on budgetary variances. So it's a real business. That's what we mean by rolling start-ups.

Another one that we're equally proud of is a company that started in our office. I was the first President. The company developed a little, tiny meter that measures blood sugars and is now used by about 50 thousand diabetics in the U.S. and Canada and is one of the market leaders. This one started out as a rolling start-up. Actually, we got our first revenues acting as a distributor. As such, we learned a lot about the marketplace, got our heads kicked in a few times, and made an awful lot of mistakes. We worked out recently how much those mistakes cost. The average mistake cost us $14,000. Now, that's not very much to learn how to get your ship back on course. So I think it comes down to a process of learning by doing. We had a lot of help on that deal from some fellows at San Jose State.

Another venture that we're very proud of came out of a combination of Michigan State and University of Michigan technology. It is one of the leaders in the machine vision business. The name of the company is Applied Intelligence Systems. Its initial start was in providing sensing devices for agricultural laboaratories to check the germination of seeds. We came to the conclusion that that was a fun business, but it was going nowhere and the technology was then diverted to the industrial sector. This company is now shipping more machine vision devices per month than any other in the country.

Another example resulted when former Dean Ragoni of the Engineering School of the University of Michigan and now President of Case Western Reserve, called us up one day and said he's got some students who really do know a lot about coaxial cable. This was, I believe, in 1972, and we got going one of the first local area network companies. Interacting Systems is the name of the company and it is now the flagship that 3-M has in the local area network business.

Our most recent effort, in fact, the closing was just a few weeks ago, is a major installation at Michigan State in the super conducting cyclotron area. We recently facilitated the establishment of a company to use that know-how in the medical field in providing a very cost effective approach to neutron therapy. The initial bedfellows are ourselves, the chief inventor, his two sons, a bunch of people on their staff, a lot of encouragement from Michigan State and Harbor Grace Hospital in Detroit. This is a start-up that we think will take 18 months before we truly prove out our point. There are the two types of start-ups and some examples.

Now, our staff and consultants are in close contact with about 15 research universities and less intense contacts with 15 to 20 others looking for additional opportunities. The real reason I came along today is, we're looking for deals. So at the same time you're briefing Walter, you might keep us in mind.

Let's talk a little bit about the process. Once an opportunity is identified, six to eighteen months is often needed to create a stand alone entity. We become deeply involved on a hands-on basis in all aspects of this start-up and organizational phase, with emphasis perhaps on five activities.

First is defining the product or products. I had a fascinating hour-and-a-breakfast meeting today with a fellow. I'll bet he covered 180 ideas in that 90 minutes, and as you know, it's tough to get one good idea done in a lifetime, so part of our process is trying to get one good idea thoroughly defined.

Second is a real understanding of the market for such products, and even more importantly, how to reach them. I think the example I gave you would be the hearing device and the use of a retail store. What we have there is a very efficient means of delivering the product to the marketplace. That's, in many cases, more important than the product itself.

Third, and this is very close to Walter's and my heart, we need a real strategy to create real value for the investors and the entrepreneurs. You know, it's fine to have a good idea, but unless, as in the case of our diabetes home monitor and so on, unless you can create real value, you could not get the R.O.I., so why make the investment?

Fourth, we spent a lot of time bringing in the key people. We are not concerned that a company's management team starts out with holes, in fact, that's an invitation to bring in very good people. One of the things I love about a start-up, you're not working with somebody else's warmed-over mistakes, you get a chance to make your own mistakes. That usually comes down to the choice of people. In the last 120 deals that I've done, I don't think we've made many product mistakes. We've obviously made some. We've made a hell of a lot of people mistakes. That's where most of the mistakes are made in our business.

I think a fifth very important thing to us is how you go about pacing the venture. What you want to do is pace the progress of the venture in such a way that you put together the fundamental attributes of a stand alone company truly capable of addressing the opportunity.

So this is the process. Let me share with you some observations. I'm going to run over my time, I make no apology.

Many universities have had experience of over ten to twenty years or more in licensing technology in doing contract work. This activity will continue. I do not think that it's mutually exclusive with starting small companies. If you reflect on the experiences in northern California and Boston, and more recently in Austin, Ann Arbor and so on, where numerous small companies have developed out of university environments, you really have seen the establishment of major regional economies. Many other universities have seen the advantages in these activities and they see a whole new way for universities to exercise their social responsibility in being pro-active as local economic development catalysts. Easier said than done, of course, but if done effectively, the results can include the following five benefits or dividends. The first benefit is a community of small companies creating local jobs and retaining university brain power in that community and a group of captive clients for that university. Second, the small companies can attract university services, the services of faculty and students. Third, small companies involve faculty and students as owners. Fourth, small companies and their entrepreneurs, and I think this is very important , serve as role models in career possibilities for faculty and students. Bob Mittelstaedt has an outstanding reputation for the role that he has played in this regard in the Philadelphia community. Fifth, the dialogue between the university and small companies creates a whole new culture that is a terribly important part of the whole thing. We see this process in healthy communities and we see an exponential growth in the whole activity.

Yesterday, I met with Bob Mittelstaedt's counterpart at the University of Michigan, David Brophy. In 1974, David wrote a manuscript describing 174 small technology-based companies around Ann Arbor that had come out of the old Willow Labs of the University of Michigan and other influences. To see the exponential growth of what's happened in Ann Arbor is spectacular. We have made a point in our own business of tracking that in the last four years and we've seen a redoubling of the number of companies being formed every six months. Very spectacular!

I should point out that the process that I described must remain entrepreneurial and totally non-institutional. You cannot institutionalize entrepreneurism. Each deal is different and must be designed by professionals to meet the circumstances. We think it's terribly important, even though our firm has grown from about 2 million dollars in 1978, looking up to now in excess of 90 million dollars, that we still be able to write $5,000 checks and $3,000 checks

and $14,000 checks and $10,000 checks. All four of those checks by the way, led to the formation of four of the better companies that we've ever been associated with. Institutionalized activities cannot write $3,000 checks.

You might ask where do you as a research university begin the process? The answer is very simple. From your strengths. I talked about Michigan State in agricultural and veterinarian areas and I don't care whether they're the best or the third best in the country; they happen to be good at it. This is a good basis for developing companies. I would like to echo Bob Mittelstaedt's point. I think universities need to be encouragers and need to make it easy, provide incentives, don't overcharge for services, but please charge for services, and expedite legal and patent reviews.

Duke mentioned universities investing in venture capital partnerships. I think you should ask your investment offices to get pledges out of those venture capital professionals to be attentive to developments of those universities. I spent some time yesterday at the University of Michigan giving a personal report to the University. I'm very grateful that that university's endowment fund was invested in one of our partnerships. I want to get them dividends, not only in cash, but in the development of the communities surrounding that University. We're doing the same thing with Lehigh University and we look forward to doing it with others.

A couple of final thoughts. Given the huge amounts of monies that large companies are spending on R&D, about 40 billion dollars a year, the whole subject of R&D efficiency and productivity is emerging as a major corporate issue. By the way, I think the recent Business Week article of July 9, could be useful to you in looking at this in some depth. As a result, we see large companies examining make or buy decisions in the research area on a rather objective basis. Rather than labor the subject, I'd refer you to the C.E.T. article of July, '84, called a make or buy decision for R&D. Music to my ears to hear that, having preached that for so many years. Not inventing here is an irrelevant concept. We believe that universities will be seen as incresingly competitive in research R&D. Universities have the client-fixed commitments which can provide services economically and lead to collaborative work.

I'd like to repeat a quote from Mr. Howard Schneider, former Senior Vice-President of Monsanto. "We believe we'll get more at Washington University than we'd get by spending the money in-house." Interesting comments from a corporate executive. Recently, my partner, Ted Doan, gave a major paper to the conference board in New York on the subject of creative approaches to funding R&D. Rather than labor that, any of you that would like a copy of the article, give me your card and I'll send it to you.

Finally, in coming back to the process, I think the university ought to get on board. There are problems to be solved, but don't get burdened with those problems. Usually they're overdramatized by lawyers who are interested in high fees to solve them. I think the more practice you get, the better you'll become. So really, you should not be standoffish at all. Thank you for letting me speak today.

MR. LEAHEY: Thank you, Ian. Our final speaker is Steven H. Holtzman. Steve is currently President of Technology Management, Incorporated. Until recently, he was the Director of the Industrial Technology and Enterprise Advisory Board, an Advisory Board to the Ohio Department of Development, charged with developing

and implementing the recently created Thomas Alva Edison Partnership Program, a 32 million dollar series of programs designated to stimulate investment in innovative technologies and encourage and facilitate formation of university-industry joint research and development ventures. Immediately prior to this appointment, Steve was an Associate Director of the Ohio Development Financing Commission, in which position he structured public financing for the expansion of innovative technology-based Ohio firms. Steve also served as a Research Associate with the Legislative Service Commission, the non-partisan research arm of the Ohio General Assembly. He received his undergraduate degree from Michigan State University and did his graduate studies at Oxford University, which he attended on a Rhodes Scholarship. Steven Holtzman.

MR. HOLTZMAN: Thank you, Mr. Leahey. I've been assigned the rather unenviable task of constituting the last obstacle between yourselves and the cocktail party. I will try to be brief.

When I was invited to this conference, as Mr. Leahey indicated, I was then in my position as the founding Director of the Edison Program for the State of Ohio and by rights would have appeared on the second program this morning dealing with state initiatives for industry/university cooperation. Since then, I've gone out and formed a new firm, so I speak to you today as an entrepreneur. The difference is this: when you work for state government, you get an $11.00 a day meal allowance. Who can eat in Dallas on $11.00 a day? As an entrepreneur, you get no meal allowance and you're paying it from the life savings you've invested in your new firm.

As part of the Edison Program, in addition to the creation of technology centers, we also instituted a project-oriented seed capital financing program for cooperative R&D, involving businesses and university-based researchers. The aspect of this program that I enjoyed most was those cases in which the university developed a technology and attempted to spin it out and form a new firm.

Now, it struck me that while state governments could provide financial incentives for this type of development, they actually could do relatively little to help universities to bridge the gap they face in attempting to transfer research results from the laboratory setting to commercialization, particularly commercialization in the context of the start-up of a new venture. It seemed to me that this would require the skills and attitudes of an entrepreneurial, business-driven private enterprise, one with a particular sensitivity to how technology transfer can enhance, rather than compromise the university's fundamental educational and research missions.

It was to this end that Technology Management, Incorporated, was founded. TMI is a company whose mission is to work with research institutions to establish and manage mechanisms to identify and evaluate technologies with high commercial potential; and then to plan and manage appropriate financing and commercialization programs for these select technologies. It's from this perspective, with special emphasis on commercialization programs that involve the start-up of new ventures, that I speak to you today. I structured by talk to try to present a generic model of how a university might be able to do some things on its own to facilitate working with businessmen to start up new businesses.

To start, and this has been stressed, advances in technology do not automatically become improved products or services introduced to the market. Instead, new products and services are the end result of a complicated process of technology transfer that can be represented as consisting of the following stages shown in Figure 1. Some of these stages are, no doubt, familiar to you. The first stage is the definition of need, followed by an idea, knowledge, research and invention. Sources of capital include self funding, small business innovative research grants, aunts, uncles, doctors, dentists, etc. It is a start-up at this stage. The next stage is technology development, patents, and a prototype. The capital source I call seed capital. It's a developmental entity. The next stage is where attention is turned to developing a business plan, market analysis is taking place, a funding plan is put together, staffing up, occurs, and, if needed, regulatory approvals are sought. This is still, in my view, a developmental entity; seed capital is still needed. The next stage occurs with initial sales. Now, we're getting into the gray area between the seed and venture stage. The company becomes a going concern and you look towards expanding the business. You build up a first-class marketing team, and maybe you move out the entrepreneur and bring in a professional manager. Here, venture capital is applicable. The last stage is commercial distribution with funding provided by going public.

Now, it seems to me that there are two unobvious points about this process. The first shouldn't be unobvious any more. That is the role of venture capital. While an important player in the development of technology, it is not, at least in my view, terribly relevant to the earliest stage technologies. Venture capital has a proper role in the American capital structure, but as a number of speakers have said today, the typical institutional venture capitalist invests in a management team and a plan; they invest in <u>businesses</u>. They do not invest strictly in technologies or an idea. There has to be an actual business that already has been put together. As the venture capitalists say, a man and a plan.

So, at the earliest stages of technology transfer, what is needed is what I call seed capital not venture capital. If I can leave you with one thought today, it would be this: at the earliest stages of technology development, more important than seed capital, in the sense of a small amount of high-risk dollars, is the commitment of a seed capitalist who is an experienced entrepreneur. What he brings to the party beyond money, are the diverse skills and experience, which you have to have to succeed. He is willing to stake his time, expertise and his reputation on the venture. There has to be this individual with the necessary skills, for the technology to receive investment attention.

Now, the second less obvious feature about this figure is that the technology transfer process, to be effective, must be managed. The phrase technology management means, the diverse set of business skills necessary to understand and manage or orchestrate this process as a whole, as well as to deal with each of its constituent parts. As has just been suggested, the model of this combination of skills is embodied in the classical high technology entrepreneur.

Figure 2 is just such a list of skills needed. These include legal, company management, marketing, financial planning, regulatory, engineering, patent and licensing, research administration, manufacturing, production, and distribution skills. As the figure indicates, managing the various developmental stages necessary even to get to the venture capital stage is quite a task. But, even

THE TECHNOLOGY TRANSFER PROCESS

TRANSFER STAGE	CAPITAL SOURCE	BUSINESS FORM
DEFINITION OF NEED/IDEA FORMED KNOWLEDGE/RESEARCH/INVENTION	SELF-FUND/SBIR	"START-UP"
TECHNOLOGY DEVELOPMENT (PATENTS) PROTOTYPE	SEED	"DEVELOPMENTAL"
DEVELOP BUSINESS PLAN MARKET ANALYSIS FUNDING PLAN STAFFING ENGINEERING/PRODUCTION REGULATORY APPROVALS	SEED	"DEVELOPMENTAL"
INITIAL SALES	SEED	"GOING CONCERN"
EXPAND BUSINESS BUILD MANAGEMENT	VENTURE	
COMMERCIAL DISTRIBUTION	PUBLIC	

Figure 1.

SKILLS NEEDED

LEGAL	REGULATORY
ACCOUNTING	ENGINEERING
MANAGEMENT	PATENTS/LICENSING
MARKETING	RESEARCH ADMINISTRATION
FINANCIAL	MANUFACTURING/PRODUCTION
PLANNING	DISTRIBUTION

Figure 2.

more important, is the business-driven perspective that brings with it the ability to see the strategic path from the laboratory to the marketplace and translate that into a business and market plan to get the technology into the marketplace. A sense of timing, if you will.

What I'd like to suggest then, is that, in effect, universities can join forces with high technology entrepreneurs to take advantage of their skills and ability to manage the technology development process. Universities should not do this simply on an ad hoc, case by case basis, waiting for a lucky wedding between a technology and a particular entrepreneur. Rather, universities can start to structure a process. To do so, we invite universities to consider the creation of a new kind of setting for the formation of joint relationships for profit. This setting would include the formation of a development corporation as a subsidiary of the university. This development corporation would play a role for the university in relationship to the business and financial communities analogous to that played by university research foundations in relationship to Federal granting agencies. It would be a repository for the technologies to come in to and also a place for business management skills.

The key to this development corporation is that it must operate with a for profit mentality. As a starting point for discussion, we suggest that the directors of the development corporation be alumni or close friends of the university; not trustees or typical university officers. I'll come back to why. The management must be, as I said, an incentive-driven, entrepreneurial team or firm. Management can be directly hired in which case your development corporation is going to have to be for profit, or you could structure the development corporation to simply be a conduit for technologies, in which case management could be contracted for or brought in as a general partner.This is the generic model.

The university would assign to this development corporation, the rights to its technologies. Then the management team of the development corporation would structure technology development programs to attract entrepreneurs into forming joint relationships with the development corporation. These joint relationships would be start-up companies that would develop the technologies.

Beginning with uncrystalized and unformed business ideas, these development entities would develop protected, patented, working prototypes that can then be marketed. In some cases, the prototype would then be used to attract venture capitalists and the company itself would eventually produce and market the new product or service. A new venture would be formed. In other cases, the prototype and technology position would be used to attract larger companies and the technology would be transferred to the larger company for commercialization via licensing or a joint venture. But even in these cases the value added to the early stage technology by running it through the structure of the development corporation should place the university in a better position to reap more benefit.

Why a separate development corporation structured this way? Separate so that the university is insulated from the business ventures that are formed, and, equally, the development corporation is insulated from the attitudes and policies governing the non-profit environment of the university. Using alumni and friends as directors, the universities gain access to individuals who are entrepreneurs, lawyers, engineers, market analysts, financial experts and so on.

Directors who are such alumni and friends, could be relied upon to evaluate, structure, and enter into joint relationships that are in the best interests of both the corporation and the university and based upon sound principles of business.

Why not trustees as directors? Trustees are charged with being conservators of the university's assets. If we are dealing with technologies, we are dealing with what might be called contingent assets. They do not have a value unless they are developed. A certain level of risk taking is necessary. You need a set of diverse attitudes which are contrary to the charter of the trustee as a conservator.

Why an entrepreneurial, business-driven management team or firm? Because only such a group will have the appropriate business perpsective to structure technology development and commercialization programs. I mentioned earlier that this development corporation and its management must operate with a for profit mentality. However, I've also suggested that the development corporation must contribute to and not detract from, the academy's guiding research and educational missions. Is that possible? We believe it is if six guiding principles for university technology transfer programs are followed . Let me just go through them quickly. First, neither the development corporation nor any joint, for profit relationship it establishes may jeopardize directly or indirectly the name, reputation or prestige of the university. Second, neither the development corporation nor any of the for profit relationships, should create opportunity costs which detract from the normal development or research activities of the university. Third, no joint, for profit relationship may involve increased financial exposures or risks to the university. Fourth, university contributions to any joint, for profit relationship should be in the form of non-cash assets, such as technology, equipment or facilities usage, expertise, etc. Fifth, whenever possible, joint, for profit relationships should be structured to provide not only cash returns to the university but also non-cash returns in the form of research and educational opportunities. And, sixth, once guidelines and policies have been established to insure the fulfillment of the previous five principles, the development corporation and any joint, for profit relationship it may establish, must be free to operate solely according to business objectives. The university must maintain an arm's length relationship to the development corporation and any such for profit relationship.

By adopting these guidelines, a university will have defined its role in the technology transfer process up-front. In so doing, it creates a new setting, friendlier to partnerships, which will allow new joint ventures to grow and flourish. You cannot proceed on a case by case basis. Though every case is a little different, you need a set of guiding policies. It will avoid serious problems that can destroy the whole process.

I would like to close by giving two examples that compare the difference between an equity interest in a company versus the standard university royalty return. The examples illustrated in Figure 3 are based on Apple Corporation and Genentech taken at the time of their initial public offerings. Imagine, if you will, that these two companies were university spin-offs. For Apple, you would have had $17 million with 10 percent royalty return while, with a 10 percent equity position, you would have held $172 million in stock. In the case of Genentech, a 10 percent royalty return would have been worth $428,000, while 10 percent equity in Genentech would have been worth $26 million. So much for royalties and the myth that they are a panacea that will fund university research. We would not be having this meeting if that wasn't a myth.

COMPARISON OF OPTIONS

--Lease vs. Equity--

"A"	ANNUAL SALES	10% ROYALTY	10% EQUITY*
1977	$ 774,000	$ 77,400	
1978	7,856,000	785,560	
1979	47,867,000	4,786,700	
1980	$117,126,000	$11,712,600	$172,615,709
		$17,354,230	
"G"			
1976	$ 1,171	$ 117	
1977	26,335	2,634	
1978	856,335	85,633	
1979	$ 3,405,804	$ 340,580	$ 26,152,350
		$ 428,964	

*AT PUBLIC OFFERING

Figure 3.

To use a real case, one of the officers of TMI structured a relationship with a university in which he took a technology, and formed a start-up company. Turning to the university, he structured a research program with the university. He then turned to the business community and structured a world-wide distribution arrangement with a major Fortune 500 company which included up-front cash that could be passed through for research at the university. Note, his was a raw, start-up company. As of today, it still has yet to produce any sales. That's just the nature of this technology; it's going to take a lot of time and development. Yet, this start-up has been funding research at the university, at a level in the high five figures per month for four years and the company has yet to make a sale. These things are possible and can be structured to work.

But the financial gains are really not that important. For the university, there are other things that are more important. The recurrent dilemma for the university has been to sell or license a technology early for a sure, though relatively modest gain, but at the loss to the university and the inventor's department of the benefits of keeping the institution integrally involved in the technology development. These include attracting top faculty and graduate students, attracting industrial talent and corporate expenditure to the area, expanding ancillary spin-off fields, and enhancing the leadership of the department and the overall reputation of the institution. The other horn of the dilemma has been for the university to take it upon itself to attempt to guide the technology along the long and unfamiliar path of entrepreneurial business development with a fair probability that the process will falter, that faculty will become alienated as they are required to assume unfamiliar and professionally unrewarding business roles, and that the technology will end up on a shelf uncommercialized. I have hoped to suggest how a university, through the creation of an appropriate technology-transfer structure and by entering into partnerships with experienced technology entrepreneurs, and can have the best of both worlds.

Thank you.

MR. LEAHEY: I admire your stamina. We have been at it for a long time today, and there are a lot of good questions here. But we only have time to touch upon a couple.

First, a question for Mr. Mittelstaedt. "Given that only a small minority of faculty can be expected to participate in and benefit from entrepreneurial activities, have you experienced or do you anticipate opposition from the majority of such faculty in an academic environment? What's the hue and cry from the faculty members who are left out?"

MR. MITTELSTAEDT: I think my point was, not that it is something that's not going to present a problem, but even though it's a minority of the faculty, it tends to be your most creative and in many cases, your most valued people that have an interest in this area. I think that it's important that the university establish some kind of an appropriate process so that you can get a reasonable buy-in to the concept of doing something that allows faculty to have some kind of business relationship.

MR. LEAHEY: I think that in our experience, there's only a small vocal minority of the faculty who are very antagonistic toward the process, but in the academic environment, they must be given a hearing. I think that's one of the things that we all need to do in terms of refining our policies. Our approach should be to have open forums with the faculty to determine what should be done.

An open question and this one is actually an extremely difficult question. I spent 45 minutes in Omaha giving a presentation on the differences between venture capital and RDLP's. We're going to try and answer it in two minutes. Does someone want to tackle the pros and cons of venture capital versus RDLP's? Ian.

MR. BUND: Duke, I'll take a fair shot at it. Venture capital is not necessarily the brand name of a dollar bill. It is a discipline to do with the business of developing businesses. I really hope that you will take that definition because that is the definition that the mainstream venture capitalists use and that is how they consider themselves. On the other hand, money is a tool or some people like to think of it as fuel for venture. One of the ways to structure a venture is along the lines of a partnership that more recently has become called R&D Limited Partnerships. Now, those kind of partnerships, by the way, have been done for a long, long time. They have been popularized since 1974, when through the Snow case, you were able to not only get your deductions, but it was verified that you can get capital gains treatment on certain kinds of royalty streams. We have seen the whole thing popularized because you patent people will find this as anathema, but under the tax laws, a partner gets deemed to be a co-inventor, and thus, a co-owner of the royalty stream. That is a nice position to be in because your ordinary income, provided in Section 1231 or 1235, property, gets capital gains treatment when it comes up.

These partnerships, by the way, had, until about 18 months ago, been very popular. The returns from them had been nominal and they have become very unpopular. They are very hard to sell right now. I think they have become a sump for the lawyers to make a lot of money, but they are not very practical vehicles. What they are is one way of funding a start-up company. There are numerous other ways of doing it. There are numerous twists on the R&D Limited Partnership format.

Suffice it to say that if there is a market for the interim tax losses that come out of a start-up, an R&D Partnership is worth considering. You might ask Lou Jackson this when he got Repligen going. He didn't spend too much time on that kind of vehicle. He had many other choices as to how to finance Repligen. I think it is important, not to get hung up on the financing technique, but rather to stand back and ask what are you trying to achieve business-wise and how can you match sources of finance to the business design? It is almost an engineering problem when you take a look at it.

We have used R&D Partnerships very sparingly. We have done three of them in the last four years. I doubt that we will do more than one per annum in the next few years. They are very time consuming, highly technical, very expensive vehicles. They have been over-sold, over-dramatized and I caution you to think of them only in the context of one type of financing vehicle.

MR. LEAHEY: I have also heard them described as the financing vehicle of last resort.

MR. BUND: I really wouldn't describe it that way. I would think that if you have a ready market of wealthy people who want tax deductions, that should be considered. But unless you have that ready market, I would be very adverse to put the time into them. The first one we did for Neogen, even though I handed the lawyers complete sets of pro forma documents, they absolutely insisted on reinventing it from scratch. It was about a $70,000 exercise that should have been done for $4,000. They also delayed the funding six months going into spurious, absolutely ridiculous questions that had no relevance to the business project. I think they're very easy vehicles to get you side-tracked. If you have got a market for people who want tax deductions, consider it. If you don't I would not spend any time on it.

MR. CAWOOD: May I just make one comment on that?

MR. LEAHEY: Please.

MR. CAWOOD: I have been advisor to individuals for over ten years and I have never bought one and never will. I do consider them the lowest form of finance. They are not a true equity investment. They do not have the potential for an unlimited return. If you have to focus on tax deductions and things of that sort for your return, you are shortchanging the business concept. So, I do not like them but I would not mind selling them to somebody if somebody else wants to buy them. I just do not want to be on the buying side.

MR. BUND: Duke, I think there's an interesting exception to the rule, as there always is. There are some professionally managed R&D pools where the investors get an opportunity for diversification. The people selecting the project have some credentials. We just made an arrangement with Prudential-Bache's partnership that did a nine million dollar contract with the Centro Corporation in San Diego that is in the vaccine business. That kind of an approach can be very efficient from a fund-raising point of view. The company made a detailed proposal to Prudential-Bache. They considered it along with many others and they went ahead with the transaction. From the point of view of you who are interested in research funding vehicles, I would seriously consider pre-existing pools that you can go to and get a reasonable turnaround. But if you are going to invent your own R&D Partnerships, unless you have a market for that kind of a thing, I would caution that it is a time zone.

MR. LEAHEY: Steve, do you want to close?

MR. HOLTZMAN: The point I was going to make is very similar to Ian's. The major difference in the past between R&D Limited Partnerships and venture capitalists, was that venture capital brought with it the value-added of experienced management as opposed to just bringing money. The pool concept involved the diversification of risk; but the key is the general partner: does he bring those value-added entrepreneurial management skills? If so, I do not know if there is much difference.

MR. LEAHEY: I do want to make mention of one thing in terms of university involvement with both. RDLP's involve salesmanship. It involves sales based on the university's name and the inventor's name. The university's alumni are sold packages. There is a great deal of salesmanship based on the university's reputation. Also, in some of the RDLP's that we have seen, the companies may go bankrupt and the lawsuits that ensue are not attractive in terms of university involvement. So I would be very cautious on how the relationship with the university is structured. If you are simply receiving a research contract, you are in good shape. If the university is involved in the initiation in the RDLP, it is assuming some fiduciary responsibilities to the investors and is something to be very careful of.

I want to thank the panel very much for being with us.

SESSION IX

UNIVERSITY ENTREPRENEURIAL SUBSIDIARIES AND AFFILIATES
A NEW DIRECTION?

MR. DUMMER: Good morning. We start now with Sessions 9 and 10. The first is entitled "University Entrepreneurial Subsidiaries and Affiliates--A New Direction?" We have all heard from time to time of unique and autonomous non-profit and other organizations which can act in a more entrepreneurial fashion than most universities and which insulate the university to some extent from outside forces and risks. Why are these organizations established, how are they controlled, and how do they relate to the university? Are they able to do things universities find difficult or impossible to do? Do they, in fact, protect from outside risks? Do they work closely with faculty members? Do they have their own separate staffs? Do they do research and product development of the type that can't be done in the university? How much of this involves actually using university resources? Is there any competition between the university and the subsidiaries in terms of securing contract support? Does such an organization bring industrial sponsors to the university or only to the subsidiary? Do they get involved with RDLP's or with venture capitalists in order to start new companies? Do they act as the sole technology transfer agent for the university including patent licensing? We have also heard of for-profit subsidiaries alone and in combination with non-profits.

Well, today I hope we will get a feeling for these kinds of institutions from Session 9. It is my pleasure to introduce your Moderator, Mark Elder, who is the Director of Pre-Award Services, Arizona State University.

MR. ELDER: Thank you, George. I assume I was chosen for this role to moderate this panel because I began my career at one of the classic non-profit research foundations, the old University of Oklahoma Research Institute. I spent some time there while I was in college at the University of Oklahoma and then spent several years at a Federal laboratory and in the aerospace industry. Within a short period of time after returning to the University of Oklahoma Research Institute, the State Legislature decided to do away with it. I am not sure that my returning had all that much to do with it, but they did decide that things that were being done there could be done better within the university. We have here the example of an institute that was in existence for a long period of time being put out of existence just at the time when it was most needed. Fortunately, that has not occurred in many of the areas.

Most of you, I think, are well familiar with the classic 501(C)3-type university research foundation, as opposed to those foundations which are organized strictly to accept gifts. You know that they act as agents for their universities, mostly state supported universities. This morning, we have very good examples of how research foundations can be used in ways not originally envisioned by the individuals who set up the Wisconsin Alumni Research Foundation and the Ohio State University Research Foundation, which are generally regarded as the two models for non-profit research foundations. Three of the foundations that will be discussed here this morning are 501(C)3 corporations. The fourth is not. It is a for profit entity set by by Case Western Reserve University.

The gentlemen who will be speaking to you are directors of their respective entities. I would like to lead-off this morning with the University Research Foundation at Maryland, which is headed by Dr. Norris J. Krone. Dr. Krone has held a number of positions in industry and in the government. He was Vice-President for Special Affairs of BDM Corporation, McLane, Virginia. He has headed the Air Vehicles Technology Office for DARPA, was a Program Manager for DARPA, Chief of the Joint Services Action Group for Joint Service R&D matters in the Pentagon, and has held other positions in the aerospace industry and for government.

Ladies and gentlemen, Dr. Krone.

MR. KRONE: Thank you very much, Mark, and good morning.

Last night, I had the pleasure of having dinner with the group that you see here. It was really good to get to know each other, but also, I found out from Mark what the batting order would be for this session. It was decided by Mark that I would be the lead-off hitter. Someone else at the table remarked that it was really very appropriate for the lead-off hitter to take a walk. Now, I thought, well okay, I'll take a walk and it will be figuratively through what a university research foundation can be and what the one at the University of Maryland is all about. But before taking the walk, every lead-off hitter has an opportunity to take a couple of swings. My swings will be in the form of a couple of ideas or points that I would like to make before getting into the discussion of the University Research Foundation at the University of Maryland.

The first idea I would like to put forth is that it is a long way between the completion of a research project, where you have possibly one individual faculty member and a couple of grad students or maybe even just a single grad student working by himself, until you have a finished, useful, commercially viable product. That long way can be in terms of time, since it can be a long wait in terms of man hours needed to actually take it from the development or the research stage into the fully developed product. Most importantly, it can be a long ways relative to the financial resources that are required to complete that development process.

Monday before last, Vice President Bush was at Long Island, N.Y. to give a talk at the unveiling of a new aircraft. It was a fighter-type aircraft and it was, in fact, a technology demonstration aircraft being proposed by Grumman for the United States Air Force. It was developed by DARPA. For those of you that don't know what DARPA is, it is the Defense Advance Research Project Agency. Now you may wonder what the connection is between what we are here for and the unveiling of an airplane? Well, this airplane is a little bit different in that it has a forward-swept wing and the research project that led to this aircraft development was done at the University of Maryland by one student. The student spent about two years working on the project and that was the end of the contribution by the university.

At some time later, the Advanced Research Project Agency and subsequently Grumman, took up the project and developed it into the concept unveiled by Vice President Bush. In fact, it hasn't flown yet--we hope it does. Airplanes do fine until they have to fly. The point is that between the end of the research project and the now-developed airplane was a period of time of about seven years during which over three thousand hours of laboratory development and research was done. In addition, I guess tens of thousands of man hours of activity and most

importantly, approximately 140 million dollars were devoted to its development. This was between the time that one individual student completed the project which in reality laid the foundation for the whole program and the airplane itself. It happened that there was a structural problem that prevented the use of the forward-swept wing previously. The student research developed a solution to the problem which involved using proper materials and advanced structural design techniques which made it possible to develop a forward-swept wing. There are certain advantages to doing that.

The point is, the development process that followed the research project was, in fact, a technology transfer period. It happened in this case to be a rather long and a rather expensive one. I am not suggesting that this is the usual case--maybe it is a more extreme case.

However, the question I would like to leave with you on this point is, what is the university's role after the basic research is over? Is there some role past that point that will continue to develop the work into a useful and practical product?

Along with that, the second point I would like to make or the second swing, if you will, is that if the university is going to do more than perform the basic research function, then there is a requirement for different varieties of organizations that are needed to function under the overall umbrella of the university itself.

At the University of Maryland, we have several organizations, in addition to the Research Foundation, that I am going to be talking about. We have an Engineering Research Center that is headed up by Herb Rabin, who has been with us here this week. One function of the Center is to incubate new start-up companies with new and exciting ideas in the environment of the university as well as to help and assist new start-up companies and companies that may be having difficulty with technological problems.

In that regard, the State of Maryland has an Office of Research under the Department of Economic and Community Development that is headed up by Bob Schoeplein who is also here this week with us. He works constantly with the university in performing a similar function, and, of course, the Engineering Research Center itself is an important part of that function. In addition, we have standard organizations within the campus structure of the four campuses that comprise the university. Each of those campuses have their own office or organization. For example, at the Baltimore City Campus, the contact is Greg Selby, who is also here with us this week.

The University Research Foundation was established in 1981 to expand the University's capabilities with the overall objective to increase University collaboration with industry and government.

I am going to walk you through what our idea of a university research foundation is. First of all, the University of Maryland is structured for the traditional educational role with the standard basic research function. There are significant capabilities in various functional areas that are not really coordinated. If you are going to go past a classical research project and get involved in the technology transfer/development aspect of bringing a concept or a new invention to fruition, we believe you have to have more than that.

An organization function that you have to have to do that must possess the capability for performing program development and marketing functions. By program development, we mean there is a need to bring other functions, other capabilities, and other personnel into the picture to really get the full focus on what activities should be pursued for producing a useful and commercially viable product. In order to do that, you not only have to have the smarts to put together the program, but you have to have some marketing capability so that you can get the resources that are required to complete the program. That is a function for which the University Research Foundation was established.

If you are going to bring these resources together and you are going to do technology transfer, at least an aspect of it within the university system itself, you have to have good program management capability. By that I mean the ability to really control costs and to control schedules, and most importantly, to make decisions when you have limited resources and you have to make basic trade-offs concerning where you put those resources. There is no organization, in my opinion, in the standard university system, that has the capability to do that automatically. Lastly, if you are going to really pursue this idea, you are going to have to have some capability to bring in outside or additional help when and where you need it.

This is the way that we at the University of Maryland see the University Research Foundation and what its real functions are. It is not universally accepted, I might say. There are still people that believe that these functions should remain outside of the university. My opinion is that you ought to have some degree of this capability within the university system if you are going to do a good job of technology transfer. The reason for not being able to do it within at least a state university system, is basically because of the statutes and regulations that exist; it is a bureaucracy within the state system. This makes it very difficult, if not impossible, to hire the right people at the right salaries. The procurement process can be cumbersome and the subcontracting aspect may be quite difficult--not that you can't do it, but sometimes it is exasperating to do it within the state system.

Some of the highlights of the University Research Foundation are shown in Figure 1. We do have a permanent technical and program management staff. We have a totally autonomous contracting and financial function which I think is really important. We are able to give supplemental compensation to faculty members and, as a matter of fact, to departments for facilities. We have an off-campus facility that allows us to do proprietary work. As a matter of fact, we have a secure facility, and have at the present time two classified programs; one under the sponsorship of the Air Force and the other one under the sponsorship of DARPA.

You might ask what are the categories of projects or how do you determine what kinds of projects ought to be performed by the University Research Foundation? The items that I have listed on Figure 2 are not categories one would say are necessarily hard and fast. If a particular research or development project should have any of the particular characterics shown it would not automatically come under the auspices of the University Research Foundation as opposed to one of the other organizations within the university. It is simply a checklist and if there are strong implications in one or more of these areas, then the project should be given consideration for the University Research Foundation. The first item shown is "heavy or complex" management including several specialists. In other words, if you really have to do an interdisciplinary job and you have to

HIGHLIGHTS OF URF ORGANIZATION AND OPERATION

- Permanent Technical and Program Management Staff
- Autonomous Contracting and Financial Functions
- Supplemental Compensation
  - Faculty
  - Departments for Facilities
- Off Campus Secure Facility for Proprietary and Classified Programs

Figure 1.

CLASSIFICATION OF UNIVERSITY RESEARCH FOUNDATION PROGRAMS

1. Heavy & Complex Program Management
   - Multi-functional
   - Severe Milestones
   - Severe Funding Limitations (deliverables)
   - Subcontracts
   - Talent outside the University
2. Proprietary
3. Classified Restrictions
4. Patent Rights
5. Rapid Response
6. Commercial Orientation
   - Service
   - Product
7. Programs marketed by URF

Figure 2.

control costs, etc. one ought to consider the University Research Foundation. I mentioned the proprietary and classified projects earlier. For patent rights difficulties, it may be more convenient under the University Research Foundation. Sometimes there is a need for rapid response. We have the autonomy and the relative smallness within the foundation, and therefore can do things a lot quicker than the University. If the project has strong commercial orientation, it might be better at the University Research Foundation. Lastly, there are opportunities that the people within the Foundation discover and generate projects to enhance the University's capabilities.

Figure 3 is the organization structure of the Foundation. We do have "plans and analysis" as a separate function. We have a separate administration, including contracting and accounting. Let me share with you some of the types of projects that have been done in the Foundation over the last couple of years. The Foundation at the University of Maryland was started as a result of the needs of the Federal Express Corporation. If they can't land their airplanes at Memphis in the middle of the night because of weather conditions they have a big problem--they can't meet their positively and absolutely overnight promise. As it turned out, without going into the full story, a couple of people at the University of Maryland had an idea for solving the Federal Express problem. Federal Express thought that it was a good idea and wanted to fund it, but they also said that if they were going to fund this program, they wanted some proprietary rights. They wanted to market it to aircraft manufacturers and to other air carriers. This presented a problem--the University wanted to do it and didn't have a good mechanism for doing it. Consequently, the ground work was laid for the formation of the University Research Foundation.

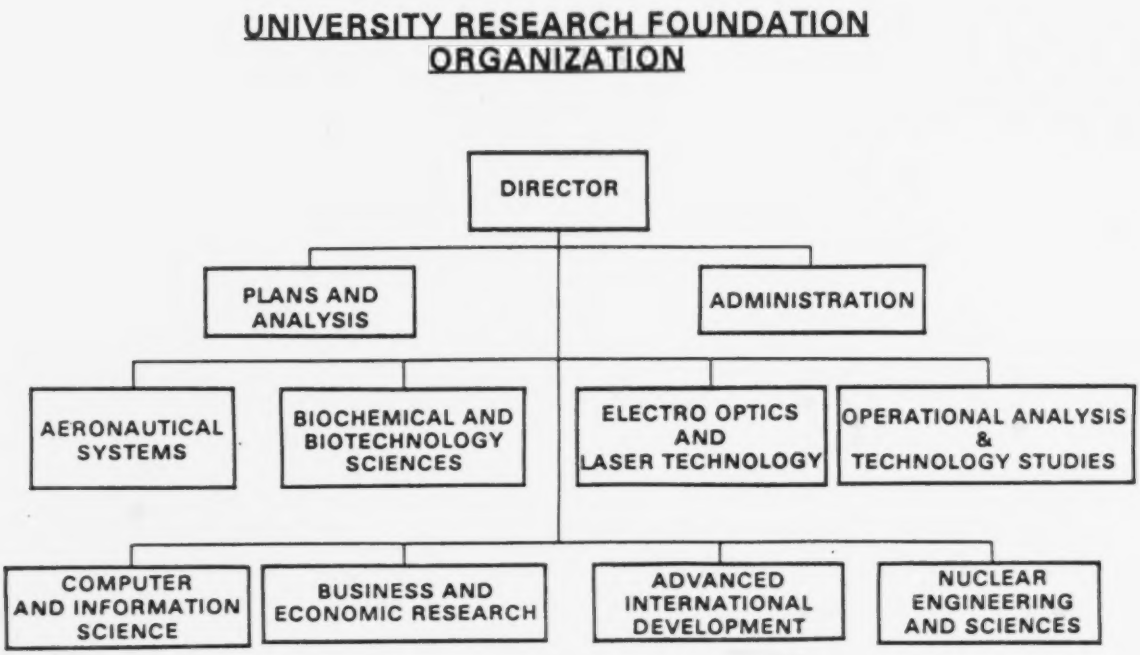


Figure 3.

Another program that kind of illustrates the function of the University Research Foundation, is one that we have with the Department of Energy. It started with the Baltimore Gas and Electric Company coming to the University with a specific problem. The problem was not exactly a research type; more of a product improvement type of an activity. The University Research Foundation people became involved in it, and saw that there was a much greater problem than what the Baltimore Gas and Electric Company had described. Through a rather long process, we developed a program that is now sponsored by the Department of Energy that is projected to be a 2.7 million dollar, 3-1/2 year effort. It is a good example of how you can develop a minor research project into a fairly decent large and meaningful program.

Well, that concludes my brief walk through of the University of Maryland Research Foundation. I would like to conclude by repeating what Vice President Bush said subsequent to the roll-out of that forward-swept wing airplane. He said if you look like a duck and you walk like a duck and you call yourself a duck and quack like a duck, then you are a duck. Well, to some degree, this is the situaton with a university research foundation. The university has to decide what it wants to have the university research foundation quack like. Thank you.

MR. ELDER: Thank you, Norris.

Our next speaker is Mr. Thomas H. Moss, who is Director of Research Administration at Case Western University. Dr. Moss has a background in physics. He has held joint appointments with Columbia and the research staff of IBM. He has been a Congressional Fellow of the American Physical Society; Staff Director of the Personnel Office of Congressman George Brown, who I am sure you know is very interested in science; and a Staff Director of the Health, Science and Research Technology Subcommittee. In that position, he was involved in the changes of the Patent Law, the Patent Right Amendments Act of 1980. Dr. Moss has been involved at Case Western in setting up a for-profit subsidiary to do a number of things. Dr. Moss.

DR. MOSS: I am grateful for the chance to be here and I am looking forward to the advice or critique I might get from you folks out there because we are at the beginning of a course which is the for-profit subsidiary course, and is different from what many universities are doing.

Basically we have established a for-profit subsidiary which interacts with my Office of Research Administration. The for-profit subsidiary will do most of our start-up oriented technology transfer activities. Now, our motivations for the for-profit subsidiary are very simple; perhaps too simple and that may be one of the things I need your advice on. I will discuss those in some detail.

I want to say a little bit about what our motivations are not, because I think they are somewhat different from the not-for-profit foundations. We are not doing it to insulate industrial or developmental research from campus activities. We see these as complimentary. So we don't feel the need to insulate. We don't have to do it to have a more flexible patent policy since we are a private institution and have a lot of degrees of freedom in what we do. We do not have to insulate the proprietary, targeted, or scheduled research or anything of that kind necessarily from what we are doing. We are not trying to set up a place where we have either more flexibility or an ability to use lower overhead

rates than we would in the University. I can understand that these considerations are very important in some settings. It is just that, happily, we are free of a number of them in our private university setting.

We have a very strong tradition of industry/university research interactions. We do not have to introduce this. We have a relatively risk-taking, adventurous administration. We have worked out, with the faculty senate, guidelines for both general industry/university interaction and for involvement of faculty in start-ups so that we do not have to fight political wars on campus every time we want to do things like this. We have a situation of relative campus peace on this. In terms of reward structures to the faculty, we have a basic policy of sharing 50 percent of any kind of commercial rewards that the University gets with the faculty, which is, I think, on the very generous side of university policies. So we do not have to have a separate place to give those kind of incentives to faculty.

We may be free of some of these constraints simply because we do not understand them. In that sense, I will gladly take advice from you. Because of newness or naivete, we may be liberated from some of the myths of the past. I think perhaps the need to insulate certain kinds of things from the campus or the need to fool with overhead rates may be in the myth category. The naivete category may have a lot of things I don't even understand.

What is the reason we are doing the for-profit subsidiary? It is one fundamental reason and that is that we want to experiment with what happens if we more actively market our technical capabilities to local and regional industry and really expand our technology transfer effort substantially. All our experience and our advice from business friends tells us, that if we want to market our capabilities, we have to pay incentive compensation to the people who will market. As you know, if we want to pay incentive compensation to anybody, we have to do it in a for-profit subsidiary. We cannot do it in the not-for-profit university environment. So marketing is the overall single, dominant goal and the for-profit subsidiary comes in to pay incentive compensation to the people who market.

Now, I used the word experiment as our goal very, very purposely. Even with the full intention of going ahead with this, we really don't know what will happen. We are not sure that it will work and we don't tell anybody we are sure it will work. We have been doing a lot of technology transfer in a sense of licensing over the last year. We had probably more than 30 agreements over a wide range of scales. Many of them have minimum royalty provisions in them and major corporate investments that makes us think they really will come to fruition. They brought in a lot of research and development firms as well as the prospects of future royalties, probably more than a million dollars in research over the next three years. We also have done our first modern spin-off start-up in the last year. We have three others that are close to completion and several in the talking stage. But all this happened with purely passive marketing, and also, I would use the word serendipitous management. That is, industrial people and entrepreneurs come to us and say we know Professor X is doing something. We would like to see him develop it in this direction. We will support R&D and we will go into a royalty arrangement with you. We say fine and we just negotiate the agreement. We often do it with free help from our friends and someone around the city in negotiating the details.

This is a very effective way to work in terms of return on investments to get a minimal investment in either marketing or internal support. We have maximum return because when people come to you and ask to go into a technology transfer agreement with you, you can be pretty sure that an agreement will be achieved. So we are very low-cost management, high return on that investment, but we do not know whether we have optimally managed our resources. If we put in more investment, we might increase returns. Right now, we are over on the side of what I call passive marketing and serendipitous management. We are getting returns for the minimal investment. We don't know what will occur in the future. As we start buidling infrastructure in marketing, will we just maintain the same return on investment or will we go up and bring the University many more returns?

There are issues that we are facing, of course, and I want to go over these with you. A key question in talking about a reward structure in a for-profit subsidiary, is what is going to be the detailed nature of that reward structure? How can it be made so that the for-profit management also reflects the broader goals of the university? What kind of reward structure will bring the for-profit goals into identity with the University's broader, long-term goals? For instance, a simple percentage of the deal is not really a good way to simply reward the management, because the University cares a great deal about the nature of the deals. If you ask the faculty what they are looking for in a technology transfer arrangement, you will hear words like fun, stimulation, newness, working with local people, trust, long-range goals, long-range relationships. Those are not necessarily the goals of somebody who is simply getting a commission on some sort of technology transfer arrangement. For the faculty and for the University, too, up front compensation for technology transfer arrangements is a very, very minor goal. We are much more interested in the long-range, skill buildings, departmental strength building kinds of arrangements. This has been our problem with national university patent organizations; that is organizations that have large infrastructures to handle patents, negotiations and so on, obviously have some sort of cash flow problem and obviously have received some sort of near-term rewards from their interaction. We don't have that problem. We want to have a reward structure from the management of our development corporation, so that they also don't have that problem.

For our for-profit subsidiary we are still in the phase of trying to negotiate a reward structure with the management. We are finding it very difficult. I think it is one of the fundamental issues in this area. Of course, our goal is that the for-profit subsidiary succeeds, so even though we are negotiating with them on behalf of the University in seeking the best deal and reward structure, we also are very intent that they succeed, because their success is also ours, even though they are distant from us.

Let me just quickly run through a few of the other issues that we are facing. As I hope I made clear at the beginning, whether this works is not an issue for us, because it is an experiment and by definition, any answer is going to fulfill our curiosity function. If this does not work in the sense of not bringing greatly increased rewards for increased investment, we will know what we wanted to know. If it does, fine too.

I haven't mentioned taxes, but, of course, that is an issue when you go into a for-profit subsidiary. We will be liable for some taxes if it is successful. The point is, do we increase the overall returns more than the tax liability that is incurred. There are ways to shelter the taxes in this arrangement and we will try to use those, of course. The most fundamental issue though, is will

our for-profit subsidiary, in the short-term or long-term, really represent our University goals? One of them is being active in our regional area in enhancing the vitality of industry. That's not necessarily the goal of the management, since it is clearly in a for-profit mode. Another University goal is faculty fulfillment; giving them a channel for their creativity. Matching our technology transfer activities to our teaching and scholarship goals is another University goal that may or may not be the for-profit subsidiary goal.

I guess I want to add one more point about this concern about divergency of goals to mitigate what I have been saying. I have been saying that I am concerned that the goals will diverge the for-profit subsidiary and the University. The thing that brings us back together always, is that the for-profit subsidiary, and I think in this case our prospective management realizes this very well, has to market in both directions. I talked about them marketing to the outside world our technological capabilities. We all know, as university research administrators, they have to also market inside to the faculty. That is, they have to demonstrate to the faculty that they really are providing easier, more stimulating, more fun, more long-range interesting interactions, whatever is channeled for faculty development because otherwise, the ideas will just not flow into that channel, whatever is the formal organizational structure. We are hoping that despite the apparent divergence of for-profit and University goals, this dual marketing concept will bring us into alignment.

The last point I wanted to note, of course, is that we also have to face the issue of how independent, in overall direction, the for-profit subsidiary is from the University. The University clearly has some responsibilities to make sure that its technology is transferred in a way that respects the governmental support or the philanthropic support that went into the basic technology infrastructure. We have an obligation to see that it is actively developed and that it is developed creatively and constructively. Somehow, we have to have some role in the supervsion of the for-profit subsidiary while at the same time we allow them to pursue a course that is independent of campus politics and those sorts of issues that often bar technology transfer activities from campus.

There is no simple solution. Again, we will be experimenting over the next few years, rather than being sure that we are on the best course.

I look forward to your questions and the discussion if there is time and any advice or critique you have on this for-profit course we are taking. Thank you.

MR. ELDER: Thank you.

Our next speaker is Dr. Patrick Tam, who is President of the Washington Research Foundation in Seattle, Dr. Tam has a Ph.D. in bio-engineering from the University of California at Berkeley and he has spent several years conducting biomedical engineering and research prior to starting a non-profit organization to transfer health care technology to developing nations. During the five years he was with that organization, he focused on licensing U.S. and European technologies to developing nations for local production to supply local needs. He was also involved in identifying appropriate products, arranging for funding for joint ventures as well as marketing the products.

Ladies and gentlemen, Dr. Patrick Tam.

DR. TAM: Thank you very much. It is a pleasure again to present to you yet another organizational structure for the technology transfer between universities and industry.

You must all be searching as to what the differences are between the four presenters in terms of the organizations that they represent. The uniqueness that I want to present is that the Washington Research Foundation is an independent, privately funded organization not associated with any one particular university. The Foundation is different from Research Corporation in that it has a regional focus and was created to help transfer technology from universities within the State of Washington.

The research institutions within the State of Washington, including the University of Washington and Washington State University, have in excess of $200 million dollars in sponsored research. From the magnitude of research grants that come to these two major universities within one single state, there is a large research base to provide more than sufficient activity for a research foundation.

Another reason for a local focus is that we need to have a more responsive structure interacting very closely with the faculty and the universities that we represent. Local focus was one of the critical issues in the formation of the Washington Research Foundation.

The Foundation was formed about three and one-half years ago with private funding in the sense that we have a line of credit from a bank. To establish the line of credit, we receive guarantees from businesses and individuals around the state. There participation comes in the hope that a more active flow of technology from campuses to industry will help promote the high-tech activities within the state, as well as drawing better faculty to these universities.

We are set up as a non-profit organization and have our own Board of Directors. Figure 1 shows the Board of Directors which consists of 50 percent university faculty or university-related persons and the other half from the business community. They include CEO's from local industry, a venture capitalist, and individuals from the banking community.

As we all know, in any new organization you want to keep overhead low and so we operate with a small staff. To get the work done, the structure that we have set up, is to use outside counsel for patent applications, as well as licensing and contract preparations. But more importantly is the use of the internship program that we are beginning to set up with the universities, both in the law school and the business school.

The focus of the Foundation is really in the marketing of technology coming out of the universities. We need to do quite a bit of homework in market analysis to find out whether something is patentable or is it to be copyrighted, as well as the commercial potential. These preliminary studies are conducted by interns that come from the law school and the business school with guidance from our staff.

Figure 2 shows the way the Foundation works with the university. We have separate and independent agreements with each of the universities with which we work. The typical arrangement requires that investigators within a certain university, for example the University of Washington, disclose inventions and technology to the University. The focal point for disclosure at the University of

WASHINGTON RESEARCH FOUNDATION ORGANIZATION STRUCTURE

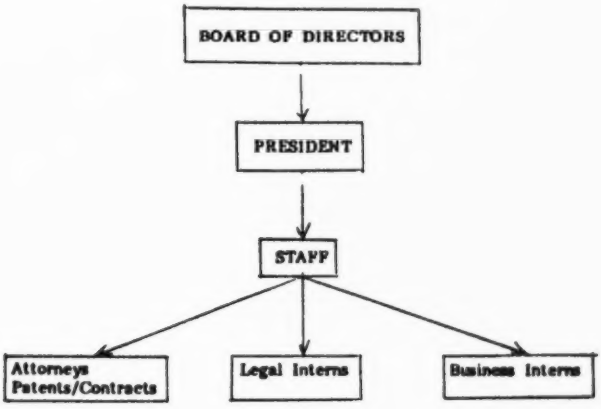


Figure 1.

RELATION OF WASHINGTON RESEARCH FOUNDATION WITH UNIVERSITIES AND INDUSTRIES IN TECHNOLOGY TRANSFER

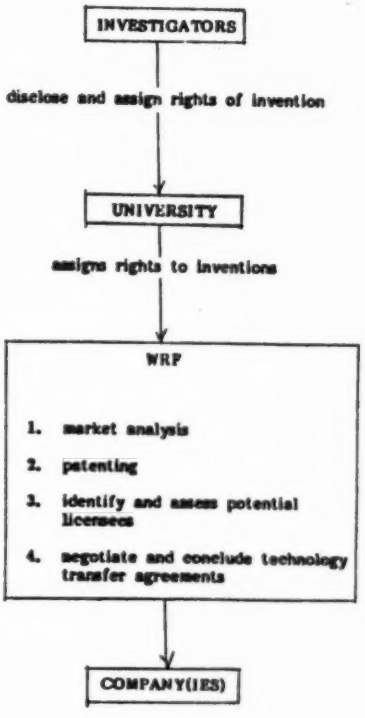


Figure 2.

Washington is the Office of Technology Transfer. This Office forwards disclosures to the Foundation for us to assess whether a particular project should or should not be pursued. If the decision is to pursue the project, then the University will assign the rights of that technology to the Washington Research Foundation.

The Foundation's obligations and duty is to conduct a market analysis and to assess the patentability of particular inventions. Once all the background information on the technology is prepared, we will try to identify licensees and assess them as to their appropriateness. We want to find the best licensees to take on the project. Once we have narrowed down the field to a few selected licensees, we will then negotiate and conclude the technology transfer agreements.

I use the term "technology transfer" because to transfer technology incorporates more than just the licensing. Very often, the whole transfer package will start with the licensing, but we always want to bring to the table that it is best to use the investigators within the university to help the company develop a product in the shortest time, because they have had experience working on the technology. So the technology transfer package usually will include the license and continued R&D contracts, as well as consultant's fees for the investigators. We also try to negotiate these fees as part of the package. Then, of course, the technology is brought to the companies.

Figure 3 illustrates details of the market analysis we prepare. As I mentioned the main focus of the Foundation is to actively market technologies to industry. It is very important for us to know how the technology stands in terms of the marketplace. We need to define what kinds of prducts can be developed from the technology. Is it going to be a consumer product? Is it going to be used primarily for research? Is it going into the military/industrial market? Since there might be a broad spectrum of products based on a single technology, we also want to identify what the competition is in the market. What kind of products are currently in the marketplace? What is the pricing structure? How are companies marketing their products? Who is the leader in the market? Then we will sit down and discuss the technology with the investigator so that we have an idea of the development needed to take the technology to a fully developed, commercial product. Is it going to be a one, three or five year project? Will it require $250,000 for additional development or $2.5 million? Is the technology so mature that it can be packaged and be marketed within six months? We also will determine the potential markets.

Sometimes the spectrum can range from a simple improvement to a radically new technology which will create a new market. For a very simple improvement we have to determine how to present it to a potential licensee. What advantage will it bring to the company? Is there going to be an increased market share? Will the company be able to increse their pricing structure so they can have a high profit margin due to the technology? If it is a new technology it becomes a tremendous task since often we are trying to define a totally new market.

From all these evaluations, we are able to determine the value of the technology. The value is usually determined by examining the potential market. Is it going to be worth $10 million or $100 million to a company over the life of the project? How much will the company invest in the technology for development? A cost/benefit analysis is one way to determine the value of a technology.

MARKETING OF TECHNOLOGIES BY WRF

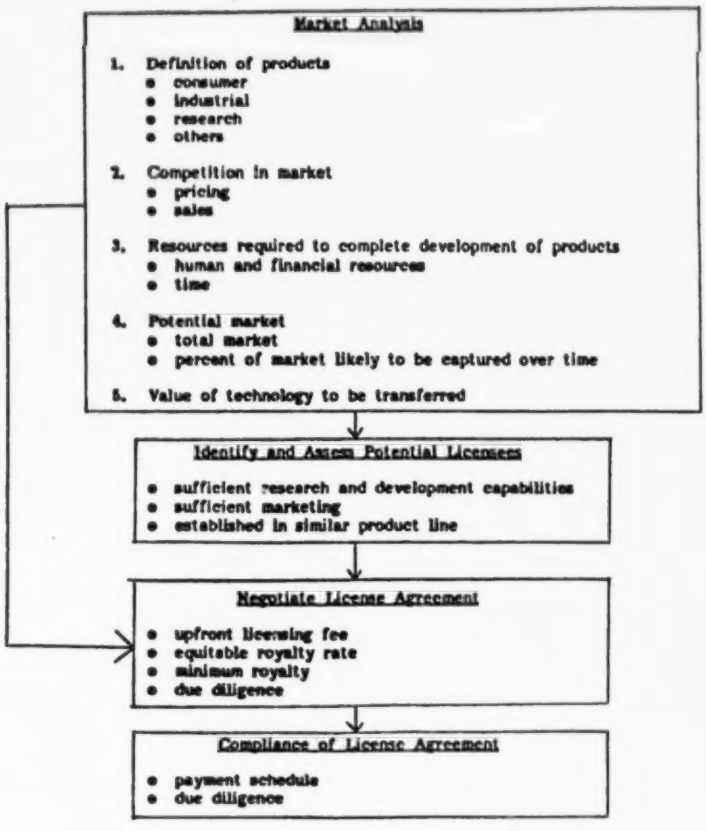


Figure 3.

This information is put together into a simplified business plan that we use for two purposes. First, it is used to present the technology to potential licensees. We do not only send an abstract on the technical aspects of the technology; we delineate the estimated dollars in revenue and expenditures if they license the new technology. This is essential in attracating the commercial interest of companies. What draws their attention to a new technology is a bottomline dollar figure that quickly allows a company to determine whether the return from the technology is worth the investment. Secondly, the business plan allows us to propose the appropriate terms for the license. As you can imagine, this background information is crucial in negotiating licenses since, in many cases, it produces the justification for the terms. After completion of the business plan, the next task is identifying and evaluating potential licensees. Evaluation is especially important. We have to determine whether a company that we approach has sufficient research and development capability to carry on complete development. Do they have the resources to develop it? Do they have the marketing means to bring it to market? Therefore, do they have the ability to exploit the full commercial potential? Does the company already have a similar product line?

As you know, the best licensees are those not currently in the product line but are very anxious to get into a particular product area. They are the ones who want to get into the market quickly and are willing to pay for technology developed elsewhere.

After we have identified those potential licensees, we will then negotiate a license agreement. A typical license agreement will consist of an upfront licensing fee, a royalty rate, and a due diligence clause. We will demand a minimum royalty and a due diligence clause to make sure that the company is making the appropriate technical progress to developing a commercial product. This is especially important in cases of exclusive licenses.

After the license is in place, the Foundation will monitor the compliance of the licensee to the license agreement, making sure that they make their payments on schedule, that they report correctly any royalty that is due, and ensuring that the interests of the university and the Foundation are well protected.

Figure 4 gives an idea of how the revenue is shared. The licensee makes payments of licensing fees and royalties to the Foundation since the Foundation is the legal owner of these technologies. After deducting direct expenses, the Foundation takes a percent of the revenue. The balance then goes to the university and the university has its own policy for distributing the proceeds amongst the investigators, schools and departments. The University of Washington has a very generous policy for rewarding investigators. Any revenue over expenses to the Foundation is issued to provide additional research at the university, such as fellowships as a means of promoting the research environment within the university. A potential use of funds is for seed capital. As we know, a lot of the technology from universities is rather raw and needs a little more money to make the first few prototypes, perhaps to write a good business plan, and so on. Seed capital investment is ideal in situations where you can invest $50,000 or $60,000 and significantly enhance the value of new technologies. We envision that the Foundation will be a source of seed capital to move some of these raw, immature technologies forward.

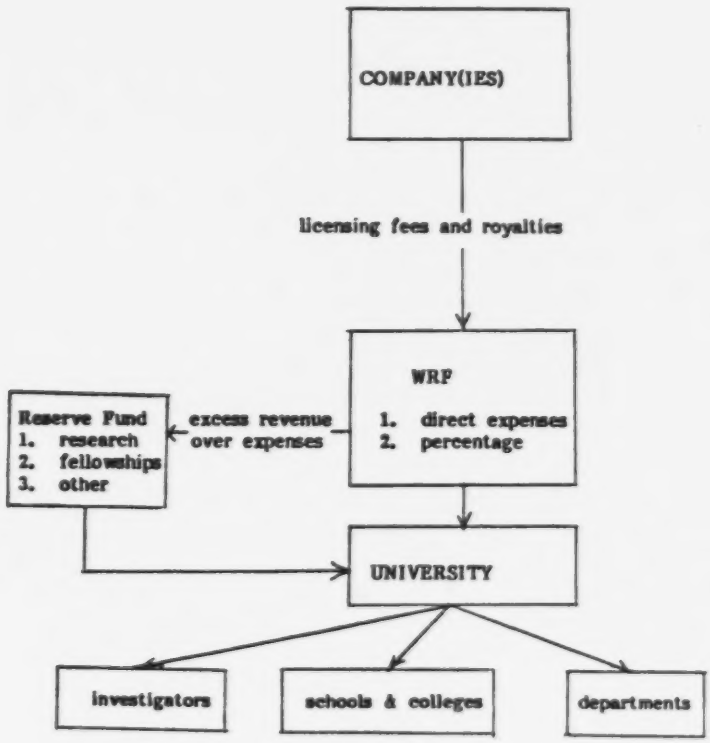


Figure 4.

To summarize, I would like to review some of the characteristics of the Washington Research Foundation. It is privately funded. One question to be answered in starting a technology transfer activity is where do you get funding? We were able to persuade a local bank to give us a line of credit backed by guarantees from industry. We have a local, regional focus of activity so that we can be responsive and work closely with investigators. We are on campus very often. It is essential to maintain high visibility with the faculty not only to make them feel that you are working hard for them but also seeking out new technologies.

A lot of disclosures are initiated by faculty members because they have conducted the research and have concluded that their new technologies have some commerical value. We try to reverse the process and take an aggressive stand in seeking out inventions. For example, the University of Washington compiles a monthly list of grants and contracts that have been awarded to the University. We scan through the list and, from the titles of research projects, judge what projects might have commercial potential. We will then meet directly with a faculty member to explain the activities of the Foundation and to find out whether indeed there is something of commercial value likely to come out of that particular department or laboratory. This is also very important in letting a faculty member know that the protection of the technology starts as early as possible, emphasizing that they keep notebooks properly, and that it is important, before they talk to companies, to have a confidentiality agreement in place with the Foundation so that everyone's interest is protected.

Another benefit of the close contact with faculty members is that we have a sense of their expertise. Industry turns to the Foundation as a window to the university, sometimes asking us to bring together three or four faculty members who are experts in a particular areas for a meeting. This will not directly impact the income of the Foundation, but it will, in general, promote better industry/university cooperation.

More importantly, because of the private and independent nature of the Foundation, we will be able to become involved in other creative ways of bringing about the transfer of technology. One of the things on which we are focusing our attention is to explore alternatives to traditional licensing as a way of transferring technology. For example, industry is very hesitant to look at technologies that have come out of a university unless the technology is mature because of the high risk in that the concept has not been reduced to a significant degree of practice.

A lot of the research foundations are looking at Research and Development Limited Partnerships (RDLP) so that they can carry on the development. What we try to do is have a local company, small in size, join us in developing a business plan to seek funding for a RDLP. At the end of that partnership, if the company decides to carry on the project to its full development, they may do so. Or we can license it to a well established company. This has been a very workable situation.

That concludes my remarks about Washington Research Foundation and I will be happy to answer any questions you may have.

MR. ELDER: Thank you, Pat.

Our last speaker is Dr. William Jackson, who is President of the Brown University Research Foundation. Dr. Jackson has a Ph.D. Degree in Physical Biochemistry from the University of Massachusetts. He has been involved as the founder and director of many high-tech enterprises. Prior to becoming President of the Brown University Research Foundation, he maintained a private consulting practice. He, along with two MIT faculty members, founded Repligen Corporation, which is a very well established, very successful biotechnology business. Prior to his founding of Repligen, he held a series of executive positions related to new business development for the medical products division of Corning Glassworks.

Dr. Jackson is honored as the last speaker because he has set up a classic corporation in the legal sense that is doing virtually all non-classic things. Dr. Jackson.

DR. JACKSON: I will give the perspective of a small private university on the workings of a separately incorporated research foundation. Brown is a relatively small school in Providence, Rhode Island with 5,300 undergraduates, 1,200 graduate students, and 420 on-campus faculty. We have a 20 year old medical school with eight affiliated hospitals. The total outside support for research from the Federal Government, industry and foundations was 31 million in the fiscal year just ended.

In the next fifteen minutes or so, I would like to give you our perspective on the advantages of having a separately incorporated Research Foundation, describe some of its activities, share with you the frustrations, and suggest some requirements for success.

First, let me give you some history. The Foundation came into being in early 1981 in response to a request from an industrial sponsor. The sponsor was about to award a one million dollar contract that was fairly complex. A European research group was involved, inventions had already been made and the general issues needing to be addressed were beyond what the sponsor felt could be handled through the normal web of university bureaucracy in a timely manner. They suggested that a foundation be established to handle this. From this start came the Brown University Research Foundation, which this month marks its first year of operation.

What we are is still evolving and we continue to explore new opportunities and new ways to act. Let me describe some of our activities. Our charter is quite simply, to be an advocate for research at Brown. We have interpreted this in a variety of ways. First and most obvious, certainly, is technology transfer. Licensing of patents and software is handled by the Foundation. We take the responsibility for protecting inventions, based on faculty invention disclosures, which are submitted through the University's Office of Research Administration. In effect, we are an outside agent with a contractual arrangement with the University. If we take an invention, we return most of the net proceeds to the University from licensing, which may be then divided according to the University's patent policy between the inventors or the inventor's department and the University. In some cases, we may license technology as part of a research contract. The technology may already be known and patented or it may be future technology developed under the contract. In these cases, the Foundation works very closely with the Office of Research Administration to establish favorable terms.

As a practical matter, most research contracts aren't administered through the Foundation even though that was the reason for its creation in the first place. The reason for this is simply to avoid duplication of administrative functions. In complex cases, the option is always open to coordinate those types of activities. In fact, we are in the early stages of working on another fairly complex one involving a European research group.

Conventional licensing, I think is not always the best way to exploit new technology. I think you have heard this message a number of times over the past few days. When a technology is sufficiently broad and addresses a large enough market need, then it may be the basis for the creation of a whole new company. In fact, I think that this is where the real action is in making money with university technology.

By forming a new corporation, several things happen. First, even if patents don't issue, something of value has been created. Second, the sale of a going concern is likely to bring much more money than royalty arrangements ever could bring. As was cited yesterday, the sale of patents or licensing, even with front-end payments, yielded about one tenth the return compared to the university taking an equity position. Third, the exploitation of technology, I think is under somewhat greater control. Let me explain what I mean. As all of you are aware, not all patent applications result in a patent issuing. It is quite rare to arrange to collect a royalty from another party on unprotected technology. However, it still may be possible to commercialize such technology. Here is where a new venture could be advantageous. By applying the know-how and resources located within the university and creating more within the new venture by developing additional technology, perhaps resulting in more patent applications and by establishing a marketing position the university can solidify its position and create something of considerable value. The university and other stockholders can sell their interests in the future for what might be considerably more than a simple licensing deal would bring. As a stockholder, the university is able to exert greater influence over the exploitation of the technology, unlike a licensing deal in which the commercialization effort may depend on a lot of other influences and priorities within the licensee organization. A caution, however; not all technologies lend themselves to this approach and, therefore, careful judgment is required. Straightforward licensing, I think, still is more appropriate for most cases.

Most likely, a single drug discovery is not the basis for a new company. You would certainly want to license to a pharmaceutical company. But if you have something that actually forms a basis for a business entity, if it is broad enough technology, then I think that the commercial venture is the way to go.

Brown is involved in several of these commercial ventures. I will describe two of them. One is based on voice recognition technology and the other is related to cancer testing. The voice recognition venture, a company called Sphere Technology, is based on some software and hardware concepts developed by a faculty member in engineering. Outside investors financed the product development stage with an initial round of venture capital and we traded the technology rights for equity. As with all ventures, the key ingredient is management talent. One of the early investors, a Brown alumnus and an experienced entrepreneur, served as Chairman of the Board. A full team has been recruited and is now in place. The first product has gone through the prototype stage and is now in field tests. A second round of venture financing is about to begin.

The other venture is based on a system that allows the effectiveness of a chemotherapeutic drug to be tested on samples of a cancer patient's tumor prior to initiation of therapy. This is a joint venture that we set up called Analytical Biosystems Corporation that has been formed with another company. The cash comes from our partner and the technology from us. The next step is to use this joint venture company as a vehicle to raise substantial additional capital to finance large-scale clinical trials. We certainly have a whole variety of financing options. We may look an R&D Limited Partnerships or simply more equity financing.

Traditionally universities have not followed this route to commercialization. The reason, in part, may be an inability of the organization in place to adapt and make things happen. A research foundation may be the answer. By adopting an entrepreneurial outlook that is always looking for a way to make money, a research foundation can focus on bringing the resources together to get a commercial venture going, and to keep it going by watching out for the University's interests after the venture is formed. Part of what the Research Foundation at Brown is trying to do is bring about a culture shift within the University to try to increse the awareness of business opportunities and interactions with the business community.

The first approach to this objective is to influence by positive example, showing that a real business opportunity can be developed without compromising academic freedoms or standards of scholarship. So far we have been successful at doing that. Certainly there are critics, but I think the critics upon hearing what's really going on, have been quieted.

A second approach has been to facilitate the interaction of faculty with business. To that end, the Foundation has established a consulting relationship with several venture capital firms in which faculty are brought in to advise on investment opportunities being reviewed by the venture capital firms. The venture firms are very good at running the numbers through and looking at the teams in place but they may not understand the technology and that is where our faculty have played an important role. This has exposed faculty to a new set of problems and a different way of thinking. I think it has been mutually beneficial.

A similar program has been established with the SBA Small Business Development Center to bring faculty help to small businesses in the state.

In addition, the Foundation has just launched the Brown Venture Forum to help encourage new business formations and provide educational opportunities for entrepreneurs. The forum is based on the successful MIT Enterprise Forum and it consists of a monthly meeting for entrepreneurs, a special clinic to help start-up companies, and a workshop program. Some of the Foundation's activities overlap with the University's Office of Research Administration and with the Development Office. This requires frequent communications, but our independent viewpoints and activities, I think, can lead to new opportunities.

In trying to market new technologies, the Foundation may make corporate contacts. If the company doesn't want to license the technology, we try to interest them in a research contract and work through the Office of Research Administration. In fact, we expect this to be the most likely outcome in most cases. Not all attempts to market a technology are going to lead to a license, but a company

may want to support a research project in a related area. To improve communication with the business community, we are creating a research directory listing projects underway in each department.

Is it really necessary to have a separately incorporated research foundation? Couldn't these things be done within existing university structures? Perhaps. Perhaps any one activity could be handled by an existing structure, but to me, the whole set of activities does justify an independent organization. We are able to focus, undistracted by university administrative matters. We are autonomous and we can make decisions fast. We are flexible and we are politically neutral. I would not underestimate the neutrality advantage. We can stir things up or smooth things over without being identified with any one function, and we can interact at all levels.

The Brown University Research Foundation is organized as a 501(C)3 corporation. Our Board of Directors consists of the President of the University, the Provost, the Dean of the Graduate School, the Vice-President for Biology and Medicine, the Senior Vice-President for Finance and Administration and the University Counsel. The organization consists of a President, your speaker, and an Executive Assistant. Operating expenses are at about 160 thousand dollars per year and we are on our way to being self-supporting.

Are there frustrations? You bet. From my perspective, with a lot of business experience prior to coming to this, I find that universities are not product development organizations. Scholarly research may serendipitously lead to new technology, patents or marketable software, but it is not the object of the research. There is no top down, hard-nosed management that is going to have progress or else. No commercial organization would survive very long under those circumstances. Well, is this really a problem? Of course not. To do otherwise would, in fact, compromise the very value of academic research. One only hopes that when faced with the question of direction, a researcher will not specifically avoid working on those things that might be practical.

Well, what does it take to get a research foundation going? The university should have a patent policy and a software and copyright policy. Not everyone does. There must be top-level support for the concept, there must be some seed money, and there must be patience.

What does it take to run a research foundation? I think it takes management sensitive to both academic and business issues, pragmatism and above all, a desire to make money.

With those ingredients, I think you might find a research foundation an interesting addition to your university. Thank you very much.

MR. ELDER: Thank you, Bill.

We started a little late and we are running short of time. We have a large number of questions. I will try to take them in order.

A great number of the questions addressed to the panelists have to do with funding. How you got there, what you are doing with it, what have you? So I would like to very quickly, in order, address a three-part question to each of the panelists. That three-part question consists of how did you get your initial funding, what do you do, and are you at a break-even point? In other words,

are you making money, if you are, what are you doing with the excess funds? Norris, would you like to lead off on that?

MR. KRONE: Yes. At the University of Maryland, the initial funding was from an initial project that came to the University. That project formed part of the start-up and the rest of it was put up by the University itself. With regards to making money, I think in any organization like this or any start-up organization, your initial profits, if you happen to have any of those, will go to increase the facilities. After all, you have to buy furniture and typewriters and word processors and those kinds of things. So the profits or the monies that have come out of the programs of the University Research Foundation have really gone to generate the facilities themselves; these hardware items that are kind of nice to have.

With regards to the initial start-up of the orgaization, that was paid back. As a matter of fact, the organization has been operating separately and autonomously from the campus at the University for a little over a year now. At this point, we are kind of struggling along with the hardware items that we have bought. Hopefully, we will start making a large profit next year.

MR. EDLER: Tom.

MR. MOSS: We haven't used much money. We have been an incredibly bootstrapish kind of organization. Actually, our for-profit has been in existence for a while and over about six years, it has made about $250,000. We are using that as the increment to take the next big step in our activities. Generally, we operate so close to the market that we don't need much funds. That is, if we have a patent strategy, we locate a licensee or an entrepreneur developer and get those costs covered with the cost of the market research as part of the deal, as opposed to doing that through some internal infrastructure. That has a lot of risks, I do not deny that, but it is a low overhead way to operate. It has saved us some money.

I wanted to say, I have some papers here, maybe not enough for everyone, to illustrate what we have done and if people want to come up afterwards, I will give you some detail of how we've done it.

MR. ELDER: Pat, I think you answered where you got your money, but what are you doing with it?

MR. TAM: The initial funding was raised in anticipation that we will break even in five years from the time of our formation. Because of the royalty cycle, you get royalty income, two or three years down the road after concluding a license agreement. In setting up a technology transfer group you would need to identify funding for about five years. We are right on schedule to reach that goal.

MR. JACKSON: Our initial funding came as a result of a software licensing deal and the fees on some contracts that were run through the Foundation. I would agree with Patrick's view on the timing for breaking even. I think it takes patience. It is going to take three to five years; that kind of timeframe.

MR. ELDER: Another set of questions of interest. I will direct this to Tom. "What is the basic reason for setting up a for-profit corporation? Why not set up a 501(C)3 and then set up a subsidiary for-profit and have the best of both worlds?"

MR. MOSS: Well, in a sense, the university itself is the 501(C)3. All of the associated kind of activities we do in the Research Administration Office. As I said, the one and dominant reason for us to set up the for-profit is so we can pay incentive compensations, and that is so that we can market. We can't pay incentive commissions to people unless it has been through a for-profit entity. We do not believe marketing is really going to be effective unless we pay people for their activities.

MR. ELDER: Okay. Pat, this one's for you. "Do you have exclusive relationships to transfer technologies from specific universities?"

MR. TAM: No, we don't. We work on a non-exclusive basis, so we have to run very fast to keep their interest and to justify that we are doing a good job for them.

MR. ELDER: Bill, you may have answered this question, but, "Would Brown have been better off with venture companies without having a separate foundation?"

MR. JACKSON: Well, I think it's all a question of where you have someone who thinks like I do. Frankly, I find a Foundation to be a nice place to live. I am not bothered by many of the administrative details of the University. I can do things that might be considered outrageous to many of the traditional academics. I think it is a great place to live.

MR. ELDER: There are also several questions having to do with relationships with faculty at universities. They center on such things as do you pay your university faculty more in the foundation than they draw in the university? How do you work with the faculty? Do you use graduate students on the projects? I think most of those were directed at you, Norris.

MR. KRONE: The question of how do we work with faculty is one of an individual relationship. What we have done is to set up a general policy for working with faculty, relative to the hard question of how much do you pay them and what is the relationship of their pay to university salary. What we have done is establish a specific policy that is a bit complicated so I won't try to explain it in detail. For a relatively long-term relationship in a part-time mode, like for example one day and a weekend or something like that, we have as a policy to pay them 1.5 times their university equivalent salary which is calculated from the formula. We did this because we wanted to avoid the haggling, over what would be paid to the faculty in each case that we use the faculty. During the last fiscal year, the Foundation paid, I believe, something like $500,000 to various faculty members.

We also have a policy for, in some way, assisting new departments out of the funds that are generated by the program. Thus not only do we tie the faculty to the projects and the rewards that can be generated, but we also provide incentives to the departments themselves. Hopefully, in that way the departments will enjoy working with the Foundation.

MR. ELDER: Another question for the entire panel. An individual states that they have not heard the situation where a non-university inventor or an idea needing the tech transfer process was involved. Does anyone here take on science from outside the university sphere? In other words, do you help people who walk in the door with an idea?

MR. KRONE: Yes. I have a specific case of an inventor who worked on a project for quite a long time and actually patented it. He came to the Foundation with the problem that he couldn't get anyone to listen to him or to help him pursue this project. What we did in that case was to go to the appropriate department and locate the necessary people--it turned out that more than one was needed. They put together a program which resulted in a proposal to the Department of Energy that had to do with a unique process for the burning of coal. Currently, we have a contact with a venture capitalist because we think that to really bring this idea to fruition is going to require at least a two and probably a three-phase program with milestones and funding requirements for each of the phases, generally to a point where we expect to have a need for something on the order of 15 million dollars. All this was generated out of this one person's idea. Now, the relationship we have with him is in the form of a signed agreement with profit and royalty-sharing agreements at the rate of 50 percent. In other words, any profits that come out of this program, if, in fact, we pursue it successfully would result in the Foundation and the University benefitting by half of the profits.

MR. ELDER: Tom.

MR. MOSS: I wanted to say that in Ohio, there is a program called the Thomas Alva Edison Innovative Research Financing Program. What it provides is that the state will match dollar-for-dollar any outside, small company investments to advance a product to prototype in the university. What this has done, of course, is to draw a lot of inventors to the university who say I need to finish my prototype. Will you go into a project with me? I can raise 50 thousand out here and then we can match it with the state money. It has drawn the university into this sort of inventor development cycle. The danger is, of course, that as anybody who deals with this knows, there is a lot of nutty inventors out there. One really needs some sort of filtering mechanisms to avoid wasting an enormous amount of time with spurious ideas.

MR. ELDER: Pat.

MR. TAM: The Washington Research Foundation does not handle any inventions from non-university inventors.

MR. JACKSON: We would not plan on undertaking such an outside relationship. There's really two aspects, I think. There's the helping and the financing. Certainly we've done some of the helping aspects through this Small Business Development Center. We have done some of the financing on outside things through a portion of our endowment at the University called the Third Century Fund, which actually acts as a venture capital group. We have had some very attractive investments through that.

MR. ELDER: We have started a little late and we have run over just a little. I will take one last question for each of the panelists. Can you give succinct examples of high-tech start-ups, successful high-tech companies that have been started up through your organization or through your involvement of your organization?

MR. KRONE: Well, we haven't had any successful, high-tech company start ups. The examples that I gave are programs that can result in high-tech companies. As a matter of fact, that's the incubator function of the Engineering Research Center for which Dr. Rabin has responsibility. He is sitting in the front row if anyone would like to ask him a question about that afterwards.

MR. MOSS: We have a classic where licensing clearly was a sub-optimal strategy. It was a software package. We had been licensing it. We realized it would soon be obsolete. Moreover, we weren't developing it into new applications and so on, so we spun it off as a start-up. It seems to be taking off very well. I think it is a good example of what a start-up is and is infinitely more effective and will have longer range impact than the licensing.

MR. ELDER: Pat.

MR. TAM: The Washington Research Foundation itself has not established any new startup companies, but the University of Washington has several projects in which startup companies have been formed. What you face with a startup company is who will put the management team together, develop the business plan and approach venture capitalists. Unless there is an outside party interested in forming a basic company, it may not be as cost effective as forming "limited partnerships", finding an established medium sized company or formulating a partnership. In a partnership you can develop the technology further and then decide whether to form a new company or license it out.

MR. JACKSON: I covered that in my talk. I will say the jury's still out as to whether these have been successful. It is certainly a three-year or more cycle time before you really know whether you have created anything of significant value.

MR. ELDER: I would like to thank all of the panelists this morning and the audience for staying with us.

SESSION X

NEEDED: COMPREHENSIVE/INTEGRATED TECHNOLOGY TRANSFER PROGRAMS

MR. DUMMER: Before proceeding further, I would like to take a moment to thank each and all of you for your attention and your responsiveness and, above all, for your durability during this conference. It has been a pleasure for me to act as your conference Chairman. I was not serious about Anchorage, Alaska at Thanksgiving, but I do hope that perhaps someday we might reconvene on this or related topics. I look forward to seeing you again. In the meantime, I thank you.

On the basis of what we have heard over the last two days, I assume that any attempt to develop an effective technology transfer program must address a number of particularly difficult questions. For example, what technology transfer functions are desirable and how do they relate to each other? Consider, for example, an existing institution which has an affiliates program reporting to a Vice President for Development, a research grant and contract office reporting to the Vice President for Financial Affairs, a patent and copyright licensing office which reports to the Vice President for Research and the University Patent Committee, an office responsible for investment decisions which reports to the Treasurer, and an office responsible for interacting with state and regional economic development officials which reports to the Vice President responsible for community affairs and government relations. This actual example is not atypical.

There are many more questions: With what external groups do technology based relationships appear desirable--large, small, medium business; the investment community; new ventures; economic development organizations? What needs and opportunities does each bring to the university? In terms of the values of the institution, how does an enhanced technology relationship with the private sector relate to the primary objectives of the institution? What fundamental academic values must be preserved?

Well, this brings us to our final session, "Needed: A Comprehensive/ Integrated Technology Transfer Program." To moderate Session 10, it is my pleasure to introduce John Richey, Director of Research and Project Administration at the University of Rochester. John.

MR. RICHEY: Thank you, George. It would be difficult to do justice to this meeting if we attempted to summarize, synthesize, or certainly project a single model of successful university-industry interaction. Therefore, we have organized our presentation a little bit differently from that. We will talk about that in a second.

We are very pleased to see all of you still here. We know you all have very busy schedules and we thought that we might have more of us up here than out there. We were taking bets around the table the other day about who would have the most questions and how we would respond to them. Not wanting to lose the bet and always in an interest in covering my flanks I brought a few extra questions along from the prior sessions so that we would have some in case you decided that you wanted to leave on us! Obviously, we won't have that problem.

The objective of this session is two-fold. One is to summarize, to attempt to synthesize, hopefully to distill and maybe even to package some of the comments of the prior speakers. Our admittedly ambitious objective is to identify the elements of successful programs in hopes of outlining a model.

We also thought that it might be useful to take a look at what had been discussed, and use this opportunity for a little point-and counterpoint-type discussion. It is an opportunity for us to raise issues that perhaps were touched upon but not sufficiently addressed as indicated by the reoccurance of specific questions. So, those are our two objectives for this session.

The way that we would anticipate meeting our objectives is to have two of our speakers provide a comprehensive view of two models of the life-cycle of the technology transfer progress from the faculty-entrepreneur's point of view. Interestingly enough, the only faculty-entrepreneur with us today, is on the podium. We have been talking at them, around them, about them, but this is the first chance, the audience has to talk to one! The comprehensive approach will be provided by one who has been in and outside of organizations and can offer contrasting points of view about how to deal with legal counsel and other similar advisors.

I should like to introduce our first speaker, George Kenney, who is the Assistant Director of the Materials Processing Center at MIT. He took both his baccalaureate and terminal degrees at MIT in Metallurgy and Applied Economics. He directs the Materials Processing Center's industrial collegium; the things that we have been talking about for some time in terms of the consortia, associations and the like. He conducts technical-economic studies related to substitution and international competition in the materials science areas. Balancing his interdisciplinary academic interests are his business ventures: he is the general partner of an R&D Limited Partnership, has been active in small business formation, and consults frequently with large and small firms.

So with that, I should like to introduce George to speak about the approach from an investigator's point of view on how it might be nice to see us all do our jobs.

MR. KENNEY: Thanks, John. It's a pleasure to be here. I had a bit of a problem in trying to determine just how I was going to approach this group and this topic, because as John points out, I come at it from about four different directions. You have to try to make sense out of that and that gets to be a little difficult at times.

What I would like to try to do is give you an overall perspective, both from a researcher's perspective, and also from an entrepreneur's perspective. I would like to talk about the Materials Processing Center, how it has evolved, how our transfer mechanism vis-a-vis industry has evolved, and how entrepreneurship fits into that setting.

Specifically, I would like to talk about three main issues. First is the relationship between science, technology, and competition in high-tech. What's the game we are playing? Then I would like to talk about technology leverage points, which is something we try to focus on in materials and how that relates to the industry-research development relationship. How do you interact with industry in that research mode? Third, I would like to talk about the Materials

Processing Center's efforts in science and technology transfer. How do we interact with industry as an organization? This specifically addresses the issue of who has the responsibility for technology transfer and what are its constant benefits. In that final discussion I would like to give you some of my impressions from the entrepreneurial side.

Let me begin with the concept behind the Materials Processing Center at MIT. What we are specifically trying to do is to provide a mechanism for combining basic science and understanding of materials with societal need and experience. We are faced with the traditional or the classical transfer mechanism. What we are trying to do in materials processing, is apply science, understanding, comprehension that had already been developed or is on the verge of being developed in the sciences and applying it to processing. Processing by its very nature implies that you will be dealing with industry. If you are going to be dealing in that forum, then you have a develop comprehensive, working relationships with industry. Materials processing specifically is that science that tries to control structure and, therefore, properties and by controlling properties of materials, enhance the performance of those materials. Materials performance enhancement specifically relates to high technology. Take any high technology, communication, transportation, computers, aerospace, and in the final analysis, you rest on the back of some material. In computers, it is silicon. The better the silicon, the better the performance of the computer. It is that simple. So we see ourselves in a very, very critical role in trying to advance this state of science, this state of technology and, therefore, we have to address ourselves to the issue of transfer.

I said I would talk about the relationship between science and technology and competition. I believe a few simple examples will illustrate the relationship. In steel making, for example, back in the early 1950's the Japanese had no steel technology and no steel industry. They effectively borrowed U.S. technology, combined that with science, science that had alredy been developed but not yet applied and created a steel industry. I need not tell you what happened. About 15 years later the Japanese technology in this area surpasses the U.S. technology. Based on the application of science to technology, on combining existing technology and emerging science, they created a new technology that essentially became preeminent. That technology base continues to expand.

There is another example. In 1969 technology was developed for growing better silicon single crystals. In 1979, Sony applied that technology to the growth of silicon crystals and in just one step, passed everyone in the world in single crystal quality and production efficiency. They passed the rest of the world in approximately one year. The U.S., through the Department of Defense, is now scrambling to catch up. I won't go into the specific science except that the point should be made that that science was developed by two faculty members at MIT in 1969, was put on the shelf and was literally taken off the shelf 10 years later and applied.

What we are talking about is the rate of application of science. It is that rate of application of science that determines competitive positions of countries, companies, and universities.

One of the problems in technology transfer, is trying to identify emerging technologies. Where are things going? You are investing for the future. So you should be looking at what the science base is now and where it could take you and what your opportunities are. Let's talk about one in particular,

advanced ceramics. How many of you are aware of what advanced ceramics are? Just a quick show of hands? That's not bad. Most of the time I get less than a 10 percent response. Advanced ceramics present an opportunity to do some very interesting things. For example, you may be able to build a ceramic engine. Why would you would to build a ceramic engine? The higher the operating temperature of an engine, the higher the performance, in terms of energy efficiency. With a ceramic engine, you could conceivably take an internal combustion engine from 30 percent thermal efficiency, up to 50 percent. If that engine were ceramic, you might also be able to do it without a radiator. You wouldn't have to cool it because that engine would run at over 2,000 degrees Fahrenheit. If it were running at such a temperature, it would have to do so without any lubricant, because what oil is going to stand up at that temperature? Think in terms of an engine with no coolant, no lubricant and 50 percent thermal efficiency and then think in terms of what that means to the automotive industry in this country. Is it a pipedream? That pipedream has been on the road for a year-and-a-half in an army truck and is doing quite well. The implication is that there is a tremendous science base being developed in advanced ceramics that is yet to be applied to technology. The application of that technology has very, very wide-ranging national implications. Specifically, in the auto industry alone, that gain is worth, 400 billion dollars over the next 20 years on a Gross National Product basis. If we dominate, we have a possible Gross National Product gain of 300 billion dollars. If we follow, the net result is a loss of 100 billion dollars. You are talking about investment opportunities. These are the kinds of things that are beginning to emerge in different science bases.

Specifically I want to address the relationship between what I call a leverage point and the transfer process. Consider the example of advanced ceramics. The key to advanced ceramics is being able to control the microstructure. With microstructural control, you can control properties and, thereby performance. For this example, microstructure is a leverage point. When you understand and can control this leverage point, you are in a position to control the transfer process. For the current example, you open up all the property applications available to you and, therefore, all the market opportunities attendant thereto.

Let us consider the arena where the university and industry can interact most efficiently and effectively. The university, in its research mode, concentrates in developing a science base. The building of the science base or the pushing back of the scientific frontiers in a particular area can provide industry with opportunities. How far this goes, is determined by what kinds of relationship you have with the industries or companies and how interested they are in the particular science base. The way that we are operating right now is that we stay fairly close to basic research and avoid a lot of the conflicts of interest that you get into when you get into real product commercialization. In other words, we do the foundation, the companies participate in that research and apply those technologies to their own benefit proprietarily. We have the founding patents. But the company is not encumbered by those founding patents to go out and build upon those to expand a market opportunity.

Consider some of the market opportunities available just in ceramics. If you control the leverage point, i.e. microstructure control, market opportunities just become phenomenal. Our effort is directed to microstructural control. By doing so, we develop a meaningful relationship with industry where we are doing the science and they are doing what they do best, which is commercialization. That leads us to the Materials Processing Center and how we operate.

Right now, we are doing four million dollars in annual research. Forty percent of that effort is supported by industries, and 60 percent by the government. NASA put in 25 percent as our founding sponsor with a 300 thousand dollar flexible grant in 1980. This is the level of activity that we have ongoing.

As I said, we focus on technology leverage points, that is, science bases that have broad commercial application. How do we use this focused approach? The first thing that we did was to establish a 27 member industrial advisory board whose membership was drawn from across industry. That industrial advisory board is also sprinkled with a few key people from the government agencies that are also interested in materials. These people act to guide our directions, but on a basic level. We use them to determine which general direction things should be going. We also use them to protect us from industry in the sense that we don't get into applications to specific products. They keep us finely focused on the science side of processing technology and allow industry to come in and access information and apply it as appropriate.

The second element is the Processing Center and it is the interested collegium which has 65 corporate members. On a research mode, we have several consortia. They are effectively multi-client-sponsored research programs where a multitude of companies supporting a research thrust. In the case of advanced ceramics, we have two consortia, one generic and one scale-up. On the generic side, what we are trying to do is develop the science base. To date, we have 27 company members that are actively supporting that research to the tune of about $35,000 each. What happens is, you have 27 companies, as large as IBM and as small as a 10 million dollar a year operation, all of which can afford to participate since the freight is fairly low. It is only $35,000, but with that money, they are buying into effectively a million dollar research operation. It is an effective tool for allowing you the financial flexibility in a research mode to do what you want to do, which is the basics, the fundamentals, while giving the industry participant access to the information that they need most. As I said, there are two consortia in this area, the other being a scale-up of some of the fundamental processes necessary to advance this particular technology.

We have one other in materials systems, which is essentially technical economic studies with 12 members. In addition to the consortia supported research is the traditional single sponsor research programs which have been the foundations of university research.

Going back to the industry collegium, some of you may be familiar with MIT's industrial liaison program. The liaison program established in the late '40's, currently has 300 members worldwide. Those members have access on a one-to-one basis with the different research and faculty people at MIT. What our industry collegium tries to do is give companies interested in materials a specific and well-focused access to research people and our Center. We do that by providing workshops in targeted areas, for example, like advanced ceramics. We have one next week on rapid solidification. What is important is that these workshops are such that we bring the 65 member companies together. Actually, it turns out you usually have about 150 to 200 participants. What you are able to do is bring together the community that can best utilize the knowledge and information that you are generating. You provide a forum for them to communicate. You've got producers, users, fabricators, investors, all in the same place at the same time. To a certain extent, it addresses itself to the collaborative mode. How do you bring people together? We use reports to allow us to get out as quickly

as possible the information on what we are doing. You all are aware of the publish or perish syndrome. At MIT I found that we generate more unpublished papers and reports than published. Most of it eventually ends up published but it takes time. We collect those unpublished papers and reports and make them available. You would be very surprised at how anxious our membership is to get hold of those.

We also provide visits and tours. Visits are anywhere from three hours to three months to three years. We encourage this kind of a transfer of people. It is only when people are moving back and forth that real transfer of concepts and ideas is occurring. Transfer isn't terribly effective on paper. It is only effective and timely when you have people involved.

The 65 membership group is a fee for service organization. Our average fee is around $7,500 per year. That generates a sizable piece of revenue. We use that revenue to support scholarships to reinforce and refertilize, if you will, the field to attract the best people to this field. Industry, our membership, is strongly behind us in this investment. When we invest our money this way we are effectively investing in their future employees. So it is a nice, close relationship.

If you are going to talk about technology leadership, you must consider re-education and continuing education. This is becoming part of the transfer mechanism at universities. The transfer of ideas and science to industry, has essentially always been a part of what we are trying to do. Specifically, I submit to you that if you are a university with your own science base and you are in an area where you have several competitors, your future prosperity is going to be determined by the rate of application of your particular expertise. In other words, if you are not transferring what you know to those who need to know, then they will be going to those who do, and it is going to be a self-feeding process.

What we have found is that the rate of application of science is speeding up. Therefore, we have had to speed up to accommodate that accelerated process. To do so requires the establishment of direct linkages to new industry and to their research facilities and to their people. It gets back to a very, very fundamental point. What is the responsibility of the university first, and foremost? It is to promote knowledge as efficiently as possible while at the same time extending the frontiers of knowledge.

Now, that breaks down into two different functions at our university. One is education and the other is research. On the education side, it is very specific. You provide the best education possible with the resources you have available to you at cost; not cost plus, but at cost. It lacks the profit motive, which is as it should be. It is a pure, intellectually motivated activity in response to a societal need. That's item number one. That's the education function.

The research, on the other hand, is used as a tool to generate new knowledge which can be used to further extend the educational process. But when we talk about research, we sometimes talk about transfer of research, or transfer of technology, and our minds get a little cloudy. All of a sudden we start focusing on the ROI. When we do, we lose, in my mind, from a researcher's perspective and from an entrepreneur's perspective, the focus on the primary issue. That primary

focus should be on using research as a tool to generate new knowledge and comprehension to further enhance the educational process. That's what we do. We raise money, we conduct research as part of the educational process and that is our function.

Now, we have a responsibility here. The responsibility is becoming much, much more apparent and pressing in that we have to transfer that information. Industry is looking for access to this information and we have a responsibility to make it available to them as readily as possible, as quickly as possible, and in an as efficient a mode as possible. If we focus on that issue of enhancement of research and work towards that goal of extending the research pace at universities and use the flexibility of the university to encompass many of the models and modes that have been discussed here over the last two days, then I think we hve an optimal system. I don't think there is any one solution to how the university interacts with industry to transfer technology.

This whole discussion, from the entrepreneurial side, has focused on RDLP's, venture capitalists and universities and how they relate. We haven't yet figured out or sorted out how the universities themselves deal with those entrepreneurs within their own ranks.

I think there is one other misconception by most outside of academic circles. They look at universities and they see just a sea of entrepreneurs. That is not true. That really is a misconception. What you have a universities are primarily inventors. One out of ten, maybe two out of ten are entrepreneurs. What we have to do is learn how to cope with entrepreneurs and inventors. There has to be a distinction made here. The university people, academic people, faculty, have chosen a very tortuous career path to take advantage of two things that they would like to do; teach and do research. The university has to develop mechanisms that accommodate these career goals and aspirations. They also have the responsibility to try to retain the best people that they can. The only way they are going to be able to accommodate the complex nature of the beast with which they are trying to deal is through being flexible. Flexibility in how you deal with the invention process and the entrepreneurial process on the campus, how you develop the mechanisms, and how you transfer relationships necessary to exploit or move out into the commercial arena the results of the research of these individuals.

MR. RICHEY: Thank you, George.

Next, we have George Stadler, who is currently Executive Vice-President for Research Corporation. George was trained in biology, chemistry and physics at John Carroll University. He has been founder and President of the University Genetics Venture Capital Corporation, which specialized principally in biotech R&D and related activities. George was also Assistant to the President for University Patents, Inc., a competitor of his current employer. Previous to that, he was Assistant Director of Research Administration at Case Western.

George will offer his perceptions of the technology transfer process as both an insider and an outsider of the academic environment. George.

MR. STADLER: Thanks, John.

Technology transfer has realy become complex in recent years. This meeting has probably convinced many of us that we don't really understand it, that the rules have changed. Just a short time ago, for example, I was concerned only with the identification, patenting and licensing of inventions. Now--in common with the rest of you--I have to consider inventions, copyrights, software, hybridomas and so on.

As head of Research Corporation's Technology Transfer Program I have to deal with third-party licensing to major corporations, look at joint ventures with small- and medium-sized businesses, and think about new start-ups, standing start-ups, rolling start-ups, RDLPs, venture capital, and state innovation programs. The technology transfer process has gotten very, very complicated!

As a university research administrator some years so, I could go to a faculty member and ask if he had any inventions, take "no" for an answer, and then go back to my office and process several grant proposals. That was a day's work. If by some chance the faculty member did have an invention, it would usually receive no more than a single outside evaluation, generally negative. No problem. I could go right back to grant proposals and negotiating overhead rates.

If this conference has a message, it is that the foregoing is no longer a valid approach. Government, industry, the public, faculty members and administrators want comprehensive programs to move technology into the marketplace to benefit the society that provided the original funding.

This conference, which emphasizes the mechanics and tools needed to make university technology transfer a dynamic and profitable process, is an interesting coincidence. A meeting on the same subject was held almost exactly ten years ago at Case Western Reserve University. I went back and reviewed the proceedings of that meeting in order to trace the paths we've followed over the past decade. What topics should this panel be dealing with in light of past history?

There were 115 participants at the Case Western conference in 1974, and that was counting all the panel members, the attendees, the janitors and the students who wandered into the auditorium looking for classes. The reports included one on the current status of university patent management by Earl Freise, I believe. Other papers described how to evaluate inventions and file patents, set up an invention administration program, and license technology.

The 1974 conference represented a turning point. It focused on the universities' responsibilities for handling inventions made in the course of government-sponsored research, and on opportunities inherent in the technology transfer process. As never before, there was a clear recognition of the need to set up mechanisms to identify, report and make available inventions. At about that time a number of universities began initial efforts to construct patent policies and to organize offices--usually subordinate to the research office--to handle inventions.

The Society of University Patent Administrators came into being as a result of that meeting, and--equally important to me--I got my first real job. Allen Moore, Director of Research Administration at Case Western Reserve, decided he needed someone with an entrepreneurial bent to get developing technologies off the ground. The salary was twice my stipend as a Ph.D. candidate--at the time it seemed a terrific increase considering that I could still do graduate work.

I later moved to University Patents, and the job at that time seemed to be to dispel in some faculty minds the notion that commercialization of research was an activity unworthy of an academic, and to convince them that patenting and publication were compatible if timely action were taken. "Just try," we would say, "to get descriptions of what you have into the research office. We'll report your finds to the government and see if we can get something underway."

Among the good results of the activities that began about that time at many universities has been the "surfacing" of valuable technology; the establishment of new mechanisms, programs and organizations to identify inventions; and an increased awareness of the potential value of research results. Invention disclosure flows are recognizable at far more institutions, and closer collaboration with industry has been fostered. Industry now furnishes a slightly higher percentage of university research dollars then formerly, and we are extending invitations to the financial community to participate in campus research.

Progress notwithstanding, few have been happy with technology transfer programs subordinate to other research office objectives. The transfer process is dynamic, and if "comprehensive integrated technology transfer" means anything, I think it means that one has to be flexible. Neither an internal university program operating in a vacuum nor an outside invention management organization can do a completely satisfactory job. The processes are complex, the resources required considerable, and there are at least several objectives worthy of accomplishment.

The answer to this quandary may be a hybrid or "cooperative" program that teams the university administrator's close proximity to the inventor with the objectivity and resources of an outside technology transfer organization. Even if a university works exclusively with Research Corporation, as some do, on-campus efforts are often essential. Lacking an administrator, these tasks may be carried out by a part-time coordinator or by outside organization staff members visiting on a periodic basis. A new relationship is needed, and I think a cooperative program makes a lot of sense.

The technology transfer organization can provide technological expertise across many disciplines, business and marketing experience, financial and legal talent, and help in handling the new broker-dealers who are coming to campus with proposals that may sound too good to be true. The outside organization should be more than a place to send problem disclosures--more than an entity that can say "no" for you when the flaws of an invention are all too obvious. Flexibility and a harmonious relationship are urgently needed.

In talking with those attending this conference, I have tried to define the principal features of a cooperative program. A major figure in the program would be a liaison officer, for lack of a better term. This person, based on campus, could be a former faculty or staff member, or a partent attorney or other specialist in technology transfer. He or she would be charged with tasks that no outside organization can satisfactorily accomplish. The liaison officer would become thoroughly familiar with the university's research program and get to know key faculty members. He or she should be skilled in human relations--have an understanding of personal quirks and egos--for inventors must be dealt with fairly and reasonably. These are things that are difficult to achieve from an office many miles distant.

The liaison officer could bring to the faculty an awareness of inventions and patents, and keep them up-to-date on changes in patent law, agreements with industry, the policies of funding agencies and the procedures of the university. Information on the patent system and the responsibilities and opportunities inherent in inventions must be presented on a continuing basis to insure that busy specialists absorb it and utilize it in a timely manner. At the same time, the liaison officer should try to foster realistic expectations. While we must open minds to the possibility of making an invention, the transfer of university technology is a difficult process. There has to be an understanding of what can be delivered and what is purely speculative.

On-campus liaison is needed not only to encourage early identification of technology, but to help generate a full disclosure of an identified invention. Securing a disclosure from an inventor is usually an interactive process, and it is best if someone on campus can insure that there is really enough information to assess patentability, technical feasibility and commercial potential. Lacking such assistance, a technology transfer organization must spent a gret deal of time collecting data on which it can base an evaluation.

Lack of communication, usually because of lack of time, has been the Achilles' heel of all technology transfer operations, internal as well as external, and Research Corporation is no exception. Someone who can function as a communications link and "hand-holder" can do a great deal to expedite the entire transfer process. Another task for the liaison officer is to collect information on local small- and medium-sized businesses and the regional business community. Acquaintances with local businessmen and executives may also be helpful; their firms might be better sources of funds to develop university technology than the major corporations.

It horrifies me that many people ignore the potential of the foreign marketplace. Because of prior publications and late disclosure to Research Corporation, an estimated 75 million dollars will be lost on technologies currently being administered. Those foreign markets could have been protected, but because there are no patent rights avialable, higher education in the U.S. will be some $75 million poorer. Many administrators assume that a licensee, if one can be located, will pick up foreign rights. It rarely happens that easily, and to the extent that foreign rights are forfeited, we are all losers.

A comprehensive invention development program using both on-campus liaison and an outside organization depends on coordination. What is needed is a team approach. The liaison officer should become a member of the licensing strategy or the technology transfer team. He may have the additional chore of attempting to get large companies to come to his campus and perhaps agree to fund research, but that can be coordinated with the invention development activities; the two are not mutually exclusive. He might take the lead in negotiating with local businesses, and use the outside technology transfer organization as a backup. The outside organization would be ideally placed to offer technologies to national and international markets.

Another important topic is seed capital and new ventures. Here an outside organization can act as a buffer, an honest broker, to protect the university. It might also provide help in initiating new business start-ups or finding management teams. An additional element that is usually neglected is the occasional need to litigate to protect good patents. Few universities have the budget--sometimes not even the legal authority--to sue for infringement. An outside organization can serve as the "warrior" in a coordinated program.

The protection and licensing of different kinds of intellectual property is another area in which a centralized organization can be of service. Research Corporation is exploring the licensing of computer software, for example, and we have long practiced a sub-speciality: the patenting and licensing of new plant varieties. The screening of compounds for pharmaceutical use by the industry often expedites licensing, but it has been widely ignored. The problem seems to be determining what the equities will be if compounds prove to be promising. We have had some experience in this area, and we may explore new avenues of cooperation.

In conclusion, I would like to point out that this conference may well represent a transition just as the 1974 Case Western Reserve meeting was a departure from a previous era. I would emphasize that flexibility is the key to a cooperative program such as I have been describing. What contributions should the university make? What should Research Corporation offer? How should we share income from successful inventions? What type of coordination will get us to that happy end-point--the point where there is income to share? How can the university best utilize Research Corporation resources? Frankly, we have money to invest, and we want to apply it to make this process work. My second point is that all of us have available university technology that is commercially undeveloped, and we need funds to bring it to the marketplace. Over the past ten years we've approached most major industrial companies in the U.S. and much of the rest of the world asking them to invest in our inventions. Now there's a new idea going around: we're going to have an easier go of it. We're going to get that development money from the financial community.

A first reaction to this idea is "don't kid yourself". We've done a lot of joint ventures, business start-ups, RDLPs, and just straight venture capital deals. They take longer to do. The exposure is higher, and you are more exposed as an institution, taking money from that public or private marketplace. I don't believe that the financial community is going to be an easier target than the business community. The returns from such transactions may be higher--if they materialize--but they will be neither easy nor relatively free from risk.

Peter Ruger, General Counsel for Washington University, is our next speaker. In that connection, I might mention that I have been spending a lot of time in London talking with our counterparts about ways to make British technology more useful to British society. One aspect of it, however--the approval of medical products in Britain--is a bit frightening. For testing purposes they've decided to use attorneys instead of white rats. There are two reasons. One is that there are more of them and they multiply faster. The other is that you don't get nearly so attached to them!

MR. RICHEY: Peter Ruger will discuss what we should or shouldn't be doing with legal counsel. He is a graduate of Denison, and received his J.D. from Washington University where he is General Counsel. He has served as an Assistant Attorney General and has been in private practice, dealing principally with business-related litigation. I would like you to welcome Peter Ruger.

MR. RUGER: Thank you. I think the award has to go to George for the best joke. Finally, I can see some ray of hope in those new regulations for animal protection. Perhaps as vertebrates, we lawyers (at least some of us have backbones) will be protected also.

Late yesterday, Ian Bund made some comments about lawyers and to be very honest, I can take good jokes like George's, but I thought his comments were very outrageous. I went and talked to some of my friends and some of your colleagues at the cocktail party and much to my surprise and disappointment, my outrage was shared only by me. Professionally, I am very saddened that many of you have had less than positive experiences with lawyers who represent you, or lawyers that you have to deal with on the other side of your transactions. Inevitably, lawyers are going to be involved in a comprehensive technology transfer process, (and even in uncomprehensive processes). Because of all the comments I have heard, I thought rather than spend a lot of time talking about some of the philosophical issues that we have heard during the course of this meeting, it might be useful for me to go over a couple of techniques that might enable you to maximize performance from your lawyers.

One thing that has concerned me as I hear these remarks is that being in Texas you might engage in the old Texas custom of lynching. I was more than pleased to see that the Texas Bar Association is right next door. When I left a few minutes ago, they were organizing a posse to come to my rescue in case anything gets out of hand in here.

When I was thinking about my talk, a number of movie titles also came to mind. One of them is "The Empire Strikes Back". Another one is "Indiana Jones and the Temple of Doom"; but perhaps most appropriately, "The Revenge of the Nerds".

I am very concerned that you see, in many cases, lawyers being obstructive. This is, unfortunately, true but it is not right.

The lawyer is a service professional. The lawyer is a glorified t.v. repairman. You've got to make sure that they provide a service to you. They have to help consummate the transaction and not impede it. As George mentioned concerning how you negotiate deals, lawyers have to be innovative and flexible. You shouldn't tolerate anything less than that. There's a trememdous danger in obstructiveness. I have seen it myself on numerous occasions. The danger is not only that that one particular deal may not be consummated, but that other future negative things could happen.

For example, in a situation involving a proposed consulting agreement that a faculty member has with a major company that manufactures items for renal dialysis, the company sent a printed consulting form. This practice ought to tell you that you are starting out in trouble. If they go to the trouble of printing it that means they are not going to want to negotiate too much. Well, every provision that they wanted our faculty member to sign was objectionable. I called their lawyer to attempt to negotiate a reasonable agreement and he said, "No, that is our standard agreement and I am not going to vary from it." Well, unfortunately for them, our faculty member involved was also the head of a unit that bought hundreds of thousands of dollars of equipment and supplies from the company each year. We no longer do business with that company. Similarly, a major software and computer hardware company refused to negotiate one of their printed purchase orders. They refused even to give a length of warranty in our deal equal to what they were advertising in magazines. This obviously alienates our Purchasing Director who goes to meetings like this and talks to his colleagues. I am sure over a period of time that company's going to lose sales from the university community because of their obdurate attitude.

Part of the problem, I think, in dealing with lawyers in technology transfer situations is that many of them are insecure and many of them have not taken the steps to educate themselves in the fundamentals of this area. I find this particularly troubling in dealing with representatives of industry. Too often, they are totally ignorant of the desires and aspirations of colleges and universities and the kind of protections that are really commonly accepted by most of the business community and sought by most of the university community. I have found that there are probably less and less of us within higher education that are equally ignorant. A lot of that is due to the efforts of our association, The National Association of College and University Attorneys, which has held numerous seminars, published articles and done a lot of work to try to educate our membership so that they can be of the greatest service to you.

I would suggest both to members of the higher education community and to members of industry that if they feel that counsel serving them are not doing a first-rate job, a first step would be to make sure that they are aware of the existence of these materials. If anyone wants to know what these materials are, you can write to me at Washington University, St. Louis, 63130. I'll provide you with a bibliography.

When you get into negotiation, let me run through a couple of things that can be helpful in dealing with counsel. First, try to work out the policy decisions first. In most situations, particularly with internal counsel, the legal office is small. They have many demands on their time. Counsel has a million things coming in and while you may think that your project is the most important, there are a hundred people out there like you in the university who feel that their project is equally important. Most attorneys don't really have the time to be involved in lengthy policy discussions. So you can really help the process by making these decisions initially. As was mentioned by one of the speakers, often the policy considerations kill a deal, not the legal consierations. So try to work those out first.

Be aware of the time demands that an attorney will have. We are not going to be real happy when a project sits around for months on your desk and you come in Friday afternoon and say you need this reviewed and commented on by Monday. That's just not fair. One the other hand, what we do like is if you give us something and say I need this back in a couple of days to a week. Give us a fixed deadline. This is very useful because we all get things piling up on our desks. Without a particular deadline, we are often not going to focus on returning items promptly. Try to have clear assignments. I know often when I work with the people in our research office, we break assignments down and, for example, divide the work load. This is generally beneficial and expeditious.

Involve the attorney in the concept of what you are doing. I think in many cases, the attorney, once they know the concept, can be removed from the day to day process. If counsel doesn't have any idea what you are trying to accomplish he or she won't be able to adequately review what you produce. You can guide and assist tremendously. Some of the best agreements that I have seen, not only in technology transfer, but any kind of university activity are those produced when the faculty member or the administrator come to me with a checklist of what they want in terms of the elements of the deal.

Similarly, in minor matters, you don't have to bring everything to an attorney. I think something that's worked out effectively in our institution is that for relatively minor contracts, your colleagues go ahead and handle them. The

Research Office will involve counsel only when a problem or question occurs. That's useful for me. It minimizes my time and allows them to proceed promptly. If you are using outside counsel, many of the things that I say about limiting the involvement of the attorney have to be said with even more emphasis because you are talking about paying people in today's marketplace around $100 an hour. So you really want to be very specific in what they are going to do. You need to make sure that you know how much money is being spent on a particular project. Outside firms can let projects get out of hand. What you can do to prevent that is to establish a budget at the front end, and get monthly billing after that.

If you are accustomed to dealing with one individual in a law firm and you like that individual, make sure you try to send the business to that person. Just don't send it down to say the managing partner and say give it to someone. They want to keep the business, so they're going to be very sensitive to having someone serve you that you have confidence in.

Let me talk about negotiating techniques briefly. Mr. Jones of Mobil said, "Researchers have no trouble negotiating, lawyers take months and months." There's a grain of truth in that. My own philosophy is that you are to go as far as you can without having the lawyers negotiate. The best negotiations and the best contracts I have seen are those in which the scientists have really worked things out. They really know where they want to go. They have talked to some of their financial people so they know what they can promise. When both parties are committed to bringing a deal to consummation, then they put a lot of pressure on the lawyers to see that it doesn't get lost in the shuffle. Now that doesn't mean that lawyers have to be ignored. An effective technique for protecting your interest is to have the lawyer consult separately with the scientists, separately with you and give you suggestions on negotiation directions and particular language. But in many kinds of matters, the longer you can keep a lawyer in the background and not in the front, the more progress you can make. I think until you hit an impasse, until you start getting into some highly technical provisions, you ought to try to do that. Keep the lawyer in the background.

But when we get involved, our counterparts from industry should strive to be reasonable. Don't say to us, when we raise objection to some really onerous terms, we've got this same agreement with 30 universities and you're the first one that challenged us. First of all, I don't believe it. I don't know who's signing them, maybe the janitor or someone like that, but don't try to make negotiating points by saying we're the only ones, particularly when our objection is pretty fundamental.

Let me make a couple of other points that are kind of esoteric. Don't use trustees to negotiate your agreements. Trustees are responsible for overall policy, but when they start negotiating, they both become the attorney and the client. You have to preserve some kind of a direction and control. The poor President of the organization and the Research Administrator have difficulty telling the trustee what to do. The proper function of a trustee is to advise and not get involved in these day-to-day things.

Try not to negotiate the final aspects of a deal with your scientists present. I think it is important initially, but as you are really trying to put the thing together in a final form, don't do that because often I've found that the scientists really impede the free flow of discussion because they're so enamored of their particular product, their technique, their patents, etc. that

they take personally any comments about the deal. They will ramble on and on about things that really aren't relevant. They will value conclusion over protection. Again, they have to be consulted, but I think as you approach consummation, keep them informed but keep them out of the face to face negotiating process.

Let me make one more comment about negotiations. The object is not necessarily to win. The objective is, in many situations, to have both parties go away feeling that they've made a good deal and that everyone has been fair and that the important considerations have been satisfied. As a litigator, I know in the courtroom, you want to win and often handle a lawsuit like Atilla the Hun. But you don't do that in contract negotiations. If your attorney has that view, I think he has to be educated.

Finally, I make one comment about something Ian Bund said. He expressed outrage at the fact that it took $70,000 to review some documents that had been used in a prior deal. That's going to be common. I think, as everyone has mentioned for the last two-and-a-half days, each deal is unique. You can start with the basic form, but you cannot take something that was used before, particularly when we're talking about the complexities of financing, patents and tort law today and the potential tax and security law violations that we all want to avoid. If, in a major deal, you simply fill in the blanks, you will wind up spending more later in unscrambling the mess you've created. Thank you.

MR. RICHEY: Thank you very much, Peter.

The last speaker is Jack Hollander, currently Vice President for Research and Graduate Studies at the Ohio State University. His doctorate is in nuclear chemistry. During the mid-1970's, he was the Director of the National Academy of Science's National Energy Study for the Carter administration. He was a professor in the Energy and Resources Group at the University of California at Berkeley. Prior to that, he did basic research in nuclear physics and research in energy and environmental problems at Lawrence Berkeley Laboratory. He is also the Chairman of the Beijer International Energy Institute in Stockholm, Sweden. I would like to introduce to you Jack Hollander.

MR. HOLLANDER: Thank you, John.

Attending a meeting like this is a bit like going to a symphony or an opera: what you take from it depends a lot on what you bring to it. I have not brought into this meeting as much as those of you who have been involved in this field for a long time. I certainly did not attend a conference on this subject ten years ago. But I have been long involved in the university research establishment, and I recall several other periods when new and seemingly unnatural partnerships were being struck. During those periods, as in this one, many people view new kinds of unions, new kinds of arrangements, with a healthy skepticism. I encountered this at my home institution and certainly have heard it here repeatedly at this conference. I recall the early days of the cyclotron in Berkely when Ernest Florence, the inventor of the cyclotron, mentioned that he was trying to secure funding from industry sources to build a new cyclotron. This approach was very unusual at the time. At a presentation Lawrence was confronted by an irate faculty member who cautioned him that industry money is tainted. He said "Sure is tainted. T'aint't enough."

Another partnership for research and development, born out of necessity, was that between universities and the Federal Government during and after World War II. There was a similar skepticism and caution at that time. Many believed that the freedom of academic research would be compromised. Of course, as you know, after World War II, the National Science Foundation was formed largely out of that concern. But what was the result, in fact? The result was that the best, the freest, the strongest research establishment that the world had ever seen was created in the United States. In fact, this move also helped build the present strength of the U.S. university research system, which is the envy of the world. There was enormous benefit to both partners in that enterprise. The very success of the university/government partnership in that period, in fact, caused a decline in what had previously been generated in university/industry collaboration. But now, as we know, the federal support of university research is not growing. In some areas it is declining. The influences here have been amply discussed at this meeting. The pressures and forces that are causing universities and industries to come together again in partnerships have been presented. These partnerships have certainly come a long way. As has been stated already, the fact that this conference is being held at this time indicates that a tremendous amount of progress has been made.

You people have gone far beyond philosophy, beyond generalities, beyond simple topics like the patent situation to exploring very complex themes and options and even experiments that you are doing in this area. You are beginning to get the feeling for what does and does not work in the university in the area of research technology transfer. There is, obviously, tremendous breadth to this topic.

President Derek Bok of Harvard, wrote in a fine paper a few years ago, "The efforts to stimulate technology transfer are in constant tension with academic pursuits". I see this tension as a very creative tension; the same kind of tension that an artist feels when performing. Without this kind of creative tension, you simply don't do your best. This tension improves both the quality and the relevance of our research, as well as stimulating the transfer of ideas and knowledge from the laboratory to the marketplace. What we are trying to do now is take stock of this creative exchange, with its tensions, after two-and-a-half days of lengthy discussion.

I would like to use, as a framework for a barief overview of this field, a simple taxonomy that includes three elements, all of which have been mentioned many times during the meeting.

The first of these three is attitudes. How do we think of each other? How do universities and industry think of each other in terms of research support, partnerships, funding and so on. The second element is communications. How do we talk to each other? The third is experiments that we are doing, interactions that we are having with each other, working arrangements that we are making, and new ventures that we are designing and conducting.

What I have chosen to do is to let the speakers speak for themselves, to highlight a few key ideas presented in the conference. Each of you, I am sure, could add more ideas that I have missed.

Let me start with the subject of attitudes. Don Langenberg told us that we should pay much attention to the cultural barriers that the universities find in expanding their horizons. We need to understand the traditions and the character

of the universities, in their conservatism and resistance to change. Tom Tolbert added that each partner in negotiations must understand and respect the culture of the others. The idea of these two cultures was touched upon repeatedly in the meeting. Tolbert also suggested that the spirit of goodwill and flexibility has come forth many times during the conference. Bill Davis reminded us that we must avoid an adversarial point of view when we're dealing with potential clients and licensees. Glenn Bandy said that universities must understand and respect industry's need for proprietary rights. On the other hand, industry must respect university's needs for openness and freedom to communicate the knowledge that has been gained in research. Harold Hall added that industry must be interested in the "E" that comes before the R&D; the education and the integration of teaching and research. He said, "In this area, universities have no competitors." We've just been reminded by George Stadler that, only a few years ago, faculty members didn't even appreciate that patenting is a legitimate activity of the university, and that one of the major areas of discussion at a conference a few years back was how to convince the faculty of this point.

On the topic of communications and what can be done to improve them, Tom Tolbert again spoke with wisdom, stressing the importance of achieving clarity at the start of interaction: "What's in it for each parter? Be sure to define equity. What do you mean by equity? What is your equity? What is the other side's? Who owes whom what?" Unique needs and expectations of both sides should be mutually and clearly understood. In this way, you can and must create a climate of confidence and understanding. Harvard Hill mentioned the concept of teaming experiments as a way to facilitate communications without excessive contractual burdens on either party. These are just a few notes on communication.

But most, by far, of the ideas expressed and the experiences discussed here had to do with experiments, interactions, and new ventures that the university and industrial communities are planning and executing with ech other. A number of areas were covered: industrial affiliates programs, licensing programs, the roles of local and state governments, the role of the investment community, limited R&D partnerships, new company start-ups, and the role of the research foundations.

On the topic of industrial affiliates programs, both David Johnson and Joe Goldstein cited characteristics of successful industrial affiliates programs and detailed advantages to both partners in successful programs. These were also mentioned by others. On the university side, these programs give exposure to the front-line problems of industry, which university researchers really need to know nowadays in order to plan their programs efficiently. These programs help build working relationships between the two parties, which can lead to research support. Johnson and Goldstein emphasize that the basic purpose of industrial affiliates programs is to bring into the universities credible, viable research efforts. They especially stressed interdisciplinary research.

On the industrial side, Johnson and Goldstein stress that the advantage to industry is gaining exposure to the best faculty, to the best students, and the best research results in a wide variety of fields that most companies cannot cover in their own organization. Last but not least, industry gets the opportunity to help shape the research efforts at the university, which they would not be ble to do if they did not have some inside exposure such as an affiliates programs. Goldstein describes industrial affiliates programs very aptly as win/win situations for both parties. John Ambrose stressed, in his discussion of industrial affiliates programs, specific services that univesities should

offer to industry if they wish the industrial side to consider an affiliates program. He stressed university services such as library services, a variety of publication services such as catalogues of research interests, and many other areas of publication services that the university can provide for industry, as well as seminars, colloquia, consulting opportunities, and opportunities for selective recruiting that might not otherwise exist.

Licensing programs have been a major traditional form of technology transfer. Many comments were made about these programs. Niels Reimers provided a detailed roadmap to the licensing procedures of Stanford, which has a very successful program. He gave us a specific example of how Stanford handles the licensing and distribution of software with a three-tier system, each tier of which is gauged to meet the needs of a particular user, from the researcher who hasn't much money but can make the program work to the lay user who might have money to pay for a more detailed effort, but needs to have the program work the first time it is turned on. These arrangements clearly were designed to fit the needs and the capabilities of the user.

Rich Cunningham demonstrated that the proof of the pudding is indeed in the eating. His success story at Penn State was that, in essence, Penn State's royalty income has gone up strikingly since the serious patent and licensing program was developed at that institution a few years back. Phil Junkins gave us a model of a novel and promising sales company from the licensing of very front-line, high-technology university research. This example at Cal Tech, and other similar efforts, are worth watching closely. Bill Davis, from the perspective of a large pharmaceutical company, gave his experiences in licensing as a basis for manufacturing. He admonished universities to heed his detailed list of do's and don't's in seeking licensing arrangements. Above all, he said, come well prepared and be specific.

We had several speakers on the topic of the local and state governments' roles. These roles have increased tremendously in recent years. Joe Goldstein and Max Kraus addressed the roles of local and state governments in catalyzing university/industry cooperation. Specifically, they described the Ben Franklin Program in Pennsylvania. Kraus mentioned that over a hundred new linkages have been created in Philadelphia alone as a result of this type of program. Steve Holtzman, described briefly the Thomas Edison program, of a similar nature, in Ohio. Graham Jones pointed out that in New York the state's objective is more than knowledge creation; it is, in fact, economic development. The same holds true in other places too, obviously. Universities must recognize this, and must understand the university's role as a partner with the state government. This is a form of university's service to the states in which they are located.

There was much discussion on the role of the investment community. Patricia Cloherty mentioned that venture capital, in fact, has no a priori or fundamental link to technology. The heart of business is the return. She used, as did many other presenters, the acronym which we heard so often in the meeting, ROI, return on investment. Universities should keep this item in mind when seeking research funds from the investment community.

On R&D limited partnerships, evidently a controversial topic, Lee Petillon suggested that this avenue of collaboration is no panacea, but can help universities unlock inventions closer to the D than the R stage. In fact, the university can play a role in structuring the technology transfer itself. We received a very strong caution from Bill Miles, who stated that universities must also

recognize the potential for damage to both their reputation and their pocketbooks if the commercial endeavor fails. He urged that universities insulate themselves as much as possible from the involved public.

In discussing new company start-ups, Bob Mittelstaedt suggested that universities should not necessarily be in the business of forming businesses themselves, but certainly should recognize and assist the entrepreneurship that exists in their most creative faculty. He stressed that the creativity which often exists in a small minority of the faculty carries with it the risk of losing these very valuable faculty members to the outside world.

Ian Bund described several interesting examples of start-up companies. He argued that many dividends accrued to universities that encourage the development of start-up companies in their neighborhoods: job opportunities for faculty and students, interaction between faculty and staff of the companies, and, certainly not least, the creation and utilization of the exciting intellectual climate, which is enhanced by these kinds of companies in the vicinities of universities. Of course these remarks also support efforts to create research parks in the vicinity of research universities.

Steve Holtzman introduced the concept of for-profit companies as subsidiaries of universities. The reason Steve gave us is simply, as he says, that royalties are nice, but equity is nicer. He illustrated his remarks with some figures that showed the tremendous advantages to universities obtaining equity positions in companies rather than receiving royalties, which, he said, would provide, at most, one-tenth the income. Royalties, in his view, result in far too little return to be used as a major funding source for research. The mechanism he described allows universities to keep their relationship with the companies at arm's length and yet provides freedom for the university to operate with wholly business objectives.

This morning, Tom Moss gave us another example of a similar for-profit subsidiary. As Tom put it, the motivation is experimental: to see whether incentive compensation for the people who actually do the marketing will produce a greater return to the university than the passive kind of marketing that has been traditional for universities in marketing the results of their research.

Norris Krone and Bill Jackson both related how a traditional structure, that is, the university research foundation, is now being used at several universities in nontraditional ways. For example, it can be used to gain equity positions in start-up companies that develop and market university technology. Another variant on the theme was provided by Patrick Tam, who described a novel regional nonprofit research foundation, which differs from most of the others because it limits its agreements to several universities in the State of Washington.

Well, these excerpts certainly only scratch the surface of many of the ideas expressed and many of the questions raised, but I do hope that they capture a bit of the flavor of the rich menu that we have sampled here in the last two-and-a-half days.

I'd like to close with a quote from the same paper by President Bok of Harvard that I referred to a moment ago. He wrote, "Translating knowledge into useful contributions that will benefit society is a proper concern of the academy, for any institution that depends so heavily on public support, has a responsibility to serve society's needs. Yet in attempting to achieve practical

results, the university must not endanger its primary commitment to learning and discovery, for these functions ultimately justify its existence and produce the greatest benefits to society." Thank you.

MR. RICHEY: We'll attempt to be brief. We've got a few questions and I will direct these to the appropriate speakers.

I should like to ask Peter the first question. One of our listeners and a member of our group here has asked if in your discussions with the men and women attorneys next door, if they have heard any good educator jokes?

MR. RUGER: No. Attorneys just provide educators with their jokes. We tell doctor jokes.

MR. RICHEY: This next quesiton is for George Kenny. I'll try to read it. "The circulation of unpublished reports and papers could be considered, in itself, a publication and a bar for patent application, particularly in certain nations." My interpretation of the question is, will protecting the proprietary rights be threatened by unpublished papers? Can you comment please?

MR. KENNEY: Yes. The distribution of those unpublished reports and papers does take into consideration the fact that you are disclosing or it is essentially a functional disclosure. The question though raises a different issue. What comes through in this question is this issue of patent rights, proprietary rights, and exploiting any opportuity to patent or license any technology. I think the point is being missed here. Let me go back to the one thing I said in my presentation. The university has a responsibility to see to the secure sponsorship of its research program for academic purposes. Well, let's take that down to a little more basic level. Let's go down to where the rubber meets the road. A faculty member in a private university has to provide half of his salary through research support. A research associate provides 100 percent. When I go out to secure a contract or grant to do research, I am more concerned with the promotion of that research. In other words, what do I have to do to get that research going? When I get it going, what do I have to do to keep it going, what do I have to do to promote it and extend it? Now, when I address the issue of patents, I look to the royalty performance of patents, academic patents and I see a few stars, a few real winners. But I studied statistics and I don't buy lottery tickets. When it gets down to it, when I write a research contract or when I engage in research, especially with an industrial sponsor, I try not to compete with that sponsor. By not competing, what I mean is, I try not to get into areas where I may get into proprietary issues in which he may be interested. He can expand information into proprietary products. What I try to do is stay on the other side where I am complimenting what his proprietary position may be. That doesn't say that I don't protect the basic fundamental proprietary rights of the research that's conducted. I do operate and I think faculty and staff in general, do operate in the university's best interests. But the facts are that when it gets down to sponsorship of research, especially when it's industrial sponsorship, you can't compete, you have to compliment. That means some give and take on the patent side, on the proprietary rights side.

In closing out this rather lengthy answer to a very simple question, I would like to point out an opportunity. We have a fair record on the performance of licenses and patents from universities. Some big winners, but in the long term, overall, I do not expect to get rich from patents that were handled through the university. Not that the university doesn't handle them well, but it hasn't

been an effective medium. The opportunity lies in the types of programs that have been discussed here such as equity positions. What you need is a comprehensive, flexible vehicle for transferring, transporting, and transmitting science into technology. You have your opportunity to go out and do it yourself and that's where you're going to make money if that's what you're interested in doing. That should be something that you are interested in doing but not solely interested in doing. Your first responsibility is to the university, or at least I feel that it is, and to the promotion of the research program second to education, and complimentary to education.

The issue of licensing of academic patents, I think, is over-worked. It gets more attention than the revenue it provides really justifies. There are other opportunities and I think that if you walk away from here with anything, it is that you have a clear view of what those opportunities are and how to take advantage of them.

MR. RICHEY: I should like to close with just a few comments. I remember the first time a few of us got together in the mid-1970's to talk about what industry was doing to us. At that time I was in the independent cancer center consortium of universities and medical care providers. Four university medical school administrators assembled to contemplate the nature of this new relationship called a commercial research agreement. We became perplexed, unhappy, angry, and quite unprepared for the number and types of changes facing us. This was one more change in the basket and we weren't sure we were quite prepared to go that route. We turned down a contract, a simple drug development contract, involving evaluation of good basic cancer, multi-modal, interdisciplinary therapeutic agents with demonstrated activity in chemotherapy. It was very straightforward and anybody would take it today. The terms and conditions weren't bad. The pharmaceutical houses, two of which were international and one was domestic, knew exactly what they wanted and they were unhappy because we did not. We just simply didn't have the maturity to know what we were doing. We have seen the cultures identified, characterized and now I think understood. The differences in the cultures are real and they are to be respected and to be acknowledged. But they are not to be used as a barrier. I think that most of us in ourdiscussions and most of us in conversations over cocktails have realized it is probably about time to build bridges, not walls. I think, in moving on, that Ed has done an excellent job in attempting to put this thing together. In that regard, Ed, I would like you to come on up and close this meeting. Thank you very much.

Ladies and gentlemen, Ed MacCordy.

MR. MACCORDY: Thank you. I have but a few brief remarks. There was one final question that was passed to me and that was, "When are we having a similar conference in the future and in what format?" In checking with George Dummer, he has found that he does have a conference right after Thanksgiving. So he and Earl Freise are organizing it to start with a costume reception on Halloween Eve. The site, out of consideration for George, has been moved closer to Boston. We'll be in downtown Sioux City, Iowa.

Really, I would like to sincerely thank the lady standing in the back of the room, Natalie Kirkman. You do not realize how much worry and concern and detail she had to deal with in making all of the arrangements for this conference, both on-site here and in getting announcements together, dealing with printers, and everything that it takes to make something like this a success. She has just

been absolutely invaluable. Thank you, Natalie. Also, I would like to thank especially George Dummer who has now learned how to play conference drop the handkerchief. He has done a masterful job as our conference Chairman. I thank you very sincerely, George. Fred Bentley has, during this experience, become the academic community's emmisary to the investment community. He has developed many, many contacts there and I'm sure he will exploit those fully for the benefit at least of Stanford in the near future.

The purpose of the conference has been achieved and the moderators have done an outstanding job. The life blood of the conference was the individual discussants, all of whom have contributed materially different viewpoints, which all comes together in giving you something to think about. Go back and decide what you are going to do at your own institution. The point we are at now is that this is not the end. Hopefully, what has been achieved is the start of a dialogue that will continue on into the future. I thank you for your patience and your stamina in maintaining your alertness during a very rigorous time schedule, too rigorous, that we imposed on you. I thank you all very much for coming.